

# PROJECT MANUAL

---

## Neuberger Hall Portland State University

Reroof  
Mechanical Replacement  
Skylight Replacement



**BID SET**  
**FEBRUARY 24, 2012**

CHA Job # 21046.01



CARLETON HART ARCHITECTURE  
322 nw 8th avenue portland, oregon 97209  
t 503 243 2252 | f 503 243 3261 | carletonhart.com

## TABLE OF CONTENTS

### **DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS (By PSU)**

NOTICE OF PUBLIC IMPROVEMENT CONTRACT OPPORTUNITY  
 PREQUALIFICATION STATEMENT  
 INSTRUCTIONS TO BIDDERS  
 BID FORM  
 BID BOND  
 SAMPLE OUS PUBLIC IMPROVEMENT AGREEMENT  
 PERFORMANCE BOND  
 PAYMENT BOND  
 OUS GENERAL CONDITIONS  
 OUS SUPPLEMENTAL GENERAL CONDITIONS

### **DIVISION 01 – GENERAL REQUIREMENTS**

011000 SUMMARY  
 012300 ALTERNATES  
 012400 ALLOWANCES  
 012900 PAYMENT PROCEDURES  
 013100 PROJECT MANAGEMENT AND COORDINATION  
 013100.01 PROJECT INFORMATION  
 013100.02 CONSTRUCTION PROJECT SAFETY FORM  
 013100.03 REQUEST FOR INFORMATION  
 013100.04 CONSTRUCTION DIRECTIVE  
 013300 SUBMITTAL PROCEDURES  
 014000 QUALITY REQUIREMENTS  
 015000 TEMPORARY FACILITIES AND CONTROLS  
 015500 CONTRACTOR PARKING  
 015600 TREE AND PLANT PROTECTION  
 015700 CONTRACTOR STAGING  
 016000 PRODUCT REQUIREMENTS  
 017300 CUTTING AND PATCHING  
 017419 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL  
 017500 INDOOR AIR QUALITY  
 017700 CLOSEOUT PROCEDURES

### **DIVISION 02 - EXISTING CONDITIONS**

024119 SELECTIVE STRUCTURE DEMOLITION

### **DIVISION 03 - CONCRETE**

030130 MAINTENANCE OF CAST IN PLACE CONCRETE  
 033000 CAST IN PLACE CONCRETE

### **DIVISION 05 - METALS**

051200 STRUCTURAL STEEL  
 055000 METAL FABRICATIONS  
 055100 METAL RAMPS  
 055213 PIPE AND TUBE RAILINGS

### **DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES**

061053 MISCELLANEOUS ROUGH CARPENTRY

### **DIVISION 07 - THERMAL AND MOISTURE PROTECTION**

070150 PREPARATION FOR RE-ROOFING

- 071413 HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING
- 075216 SBS MODIFIED BITUMINOUS MEMBRANE ROOFING
- 075556 COLD FLUID-APPLIED PROTECTED MEMBRANE ROOFING
- 076200 SHEET METAL FLASHING AND TRIM

**DIVISION 08 - OPENINGS**

- 086300 METAL-FRAMED SKYLIGHTS
- 088000 GLAZING

**DIVISION 09 - FINISHES**

- 099000 EXTERIOR PAINTING

**DIVISION 23 - HVAC**

- 230000 BASIC HVAC REQUIREMENTS
- 230513 MOTORS AND COMMON ELECTRICAL WORK FOR HVAC SYSTEMS
- 230548 VIBRATION AND SEISMIC CONTROLS FOR HVAC
- 230553 IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT
- 230593 TESTING ADJUSTING AND BALANCING FOR HVAC
- 230700 HVAC INSULATION
- 230900 INSTRUMENTATION AND CONTROL PERFORMANCE
- 232300 REFRIGERANT PIPING
- 236200 PACKAGED AIR-COOLED REFRIGERANT COMPRESSOR AND CONDENSOR UNITS
- 238143 AIR TO AIR HEAT PUMPS

**DIVISION 26 - ELECTRICAL**

- 260000 BASIC ELECTRICAL REQUIREMENTS
- 260501 ELECTRICAL DEMOLITION
- 260509 EQUIPMENT WIRING
- 260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
- 260533 RACEWAYS
- 262800 OVERCURRENT PROTECTIVE DEVICES

**APPENDICES**

- APPENDIX NEUBERGER HALL ASBESTOS SURVEY 2008

1

END OF TABLE OF CONTENTS

## SECTION 011000 - SUMMARY

## PART 1 - GENERAL

## 1.1 WORK COVERED BY THE PROJECT MANUAL AND DRAWINGS

- A. Work covered by the Project Manual and Drawings consists of:  
Neuberger Hall  
Roof, Skylight and Mechanical Replacement  
Portland State University, Portland Campus  
724 SW Harrison Street  
Portland, Oregon
- B. The work includes:  
At the main roof and mechanical penthouses: Removal of existing roofing, insulation, flashings, and noted ladders and abandoned equipment and antenna as noted on the drawings. Preparation of substrates and installation of new cold applied rubberized asphalt waterproofing system, extruded polystyrene insulation with integral ballast/paver topping. New overflow scuppers are to be installed at the main roof level and additional drainage scuppers at the upper penthouse levels. Installation of new metal flashings and counter flashings throughout. Installation of new metal access ramp and landing where indicated.  
  
At the mechanical roof, mechanical plenum and elevator roofs: Remove existing EPDM membrane, insulation and flashing. Install new tapered insulation, cover board, SBS roof membrane and associated metal and membrane flashings, new gutters and downspouts as indicated on the drawings. Installation of walkway pads as indicated.  
  
Installation of flashing and counter flashings where indicated. Installation of new metal ramps and landing. Reinstallation of removed components. Repainting of existing structural metal fabrications and existing access ladders. Raising mechanical curbs where necessary to meet waterproofing membrane manufacturer's requirements.  
  
The  
  
See Alternates Section 012300 for complete list of alternates.
- C. The Contractor shall supply all labor, transportation, apparatus, scaffolding, tools and other items necessary for the completion of the work in conformance with OUS General Conditions for Public Improvements Contracts, Section A.2.
- D. The Work shall be started within ten (10) calendar days following approval of the Contractor's Certificate of Insurance and the Execution of Contract by PSU Facilities, attention (fapcontracts@pdx.edu). All work shall be final completed within the time frames established in the Public Improvement Agreement Form (OUS Contract Form B-7, Item 4). Time is of an essence on this project. Failure to complete the project within the time specified will result in damages to the Owner. The Contractor will be charged liquidated damages in accordance with Item 5 of the Public Improvement Agreement Form (OUS Contract Form B-7). Liquidated damages will be deducted from the Contractor's Final Payment Request.

## 1.2 CONTRACTOR'S USE OF PREMISES

- A. Contractor shall limit use of the Premises for Work and storage to allow for:
1. Owner and tenant occupancy of adjacent spaces, day and night

2. Public use, day and night
  3. Security
  4. Safe entry and exit for vehicles and pedestrians
- B. Access through the interior of the building will be coordinated with the Owner's Authorized Representative.

### 1.3 PROTECTIONS

- A. Protect sidewalks, asphalt paving, concrete, trees, shrubs, and lawn areas at all times from spillage of materials used in carrying out the Work. Prevent materials from clogging sinks, catch basins and yard drains; maintain drains clean and in proper working conditions. Dumping of plaster, solvents, or other injurious materials in PSU plumbing systems is not permitted. Costs of cleaning or repair will be withheld from Contractor as required.
- B. Clean, repair, resurface, or restore existing surfaces to their original, or better, condition, or completely replace such surfaces to match existing, where damaged by construction operations.
- C. The Contractor shall be responsible for any and all damages as specified in OUS General Conditions for Public Improvement Contracts Section G.1.1..
- D. The Owner will not be responsible for protection of materials or equipment from vandalism or theft. Security is the responsibility of the Contractor. See Section 015000 Temporary Facilities.
- E. The Contractor will verify that all drains in the construction area are in working order and notify the Owner's Representative, in writing, of any drains that are plugged, prior to the Start of Work. Start of Work will be considered as acknowledgement that all drains are clear and in good working order.
- F. Debris shall not be allowed to remain around the buildings during performance of Work, and shall be disposed of daily and/or as directed by Owner's Authorized Representative.
- G. The Contractor shall manage a safe job environment for both the safety of all people around the Premises as well as the safety of the Owner's and general public's property.
- H. Do not store materials where they will interfere with operations of Owner. Storage areas must be approved by the Owner's Authorized Representative prior to start of the Work.

### 1.4 OWNER OCCUPANCY

- A. The Owner and building tenants will occupy the Premises during the entire period of construction for the conduct of normal operations. Cooperate and coordinate with Owner's Authorized Representative in construction operations to minimize conflict and to facilitate the Owner's usage, especially in the following areas:
1. Restricted access and parking
  2. Use of elevators and stairs
  3. Temporary storage space availability
  4. Provide a written schedule of Work specifying where and when Work will be accomplished
  5. Notify Owner's Authorized Representative a minimum of 72 hours prior to performing any work that will release strong odors or fumes, causes noise, or requires windows to be closed during hot weather. See Section 017500 for additional Indoor Air Quality requirement, which includes coordination of noise abatement.

- B. Conduct operations in such a way to ensure the least inconvenience to University staff, students and the general public.
- C. To maintain continual operations by the Owner and building tenants, evening and/or weekend work by the Contractor will be required for short durations at various stages of the Project. Coordinate with the Owner's Authorized Representative at least seventy-two (72) hours in advance to performing evening or weekend work.

#### 1.5 SALVAGE

- A. All material indicated to be removed shall become the property of the Contractor except those items noted on the drawings and in the specifications as being retained by the Owner.
- B. All locksets, cylinders and strikes removed shall be returned to Owner. Coordinate with Owners Authorized Representative.
- C. The City of Portland has mandated the recycling of demolition materials. See Section 017419 of these Specifications for Waste Management requirements, which includes recycling documentation to be provided to the Architect and Owner by the Contractor.

### PART 2 - PRODUCTS

#### 2.1 REUSE OF EXISTING MATERIAL

- A. Except as specifically indicated or specified, materials and equipment removed from existing construction shall not be used in the completed Work.
- B. For material and equipment specifically indicated or specified to be reused in the Work or salvaged to Owner:
  - 1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
  - 2. Arrange for transportation, storage, and handling of products that require off-site storage, restoration or renovation. Pay all costs for such Work.
  - 3. Contractor shall be responsible for removing and reinstalling mechanical units, vents, guys, antennae, and electrical and grounding wires or conduits.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Inspect existing conditions, Work requirements, and the Contract Documents. Verify that materials and equipment being furnished meet requirements specified. Report any discrepancies to the Owner's Authorized Representative prior to proceeding with work.

#### 3.2 MATERIAL HANDLING

- A. If, in the opinion of the Contractor, cranes, hoists, towers, or other lifting devices are necessary for the proper and efficient movement of materials, comply with these requirements:
  - 1. Use only experienced personnel
  - 2. Remove equipment as soon as possible after task is ended

3. Coordinate the placement of such equipment with the Owner's Authorized Representative to ensure that utility tunnels, utilities, and surfaces are not damaged.
4. Obtain required permits and meet the requirements of governing authorities regarding street and sidewalk closures, safety, noise, and other applicable regulations.
5. Provide barricades and warning ribbons to close off areas temporarily for loading and unloading, to insure public safety.

B. Contractor shall not allow any materials or debris to free-fall from the building.

### 3.3 WORKMANSHIP

- A. Unless otherwise specified, perform the Work using workers skilled in the particular type of Work involved.
- B. Should the Owner or the Architect, in writing, deem anyone on the Work incompetent or unfit for the assigned duties, dismiss the worker immediately or reassign that worker to a different task requiring a lesser degree of competence.
- C. Workmanship shall be first class in every respect as determined by the Owner's Authorized Representative and Architect, and all Work performed shall be performed in accordance with standard industry practice.
- D. The Contractor shall maintain effective supervision on the project at all times Work is being performed. The Superintendent shall be the same person throughout the course of the Work, and shall attend the pre-construction conference.

### 3.4 TESTING

- A. The Owner reserves the right to perform any testing as may be required to determine compliance with the Project Manual and Drawings. Costs for such testing will be the Owner's responsibility unless testing indicates noncompliance. Costs for testing which indicates noncompliance shall be borne by the Contractor. Non-complying Work shall be corrected and testing will be repeated until the Work complies with the Project Manual and Drawings. Contractor will pay costs for retesting non-complying Work.
- B. The Contractor shall cooperate in every respect with the activities of the testing agency.

END OF SECTION

## SECTION 012300 - ALTERNATES

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. Work of the Section includes administrative and procedural requirements to the Bid Alternates of the OUS Bid Form (OUS Form B-6).

## 1.2 RELATED WORK IN OTHER SECTIONS

- A. Additional information regarding bid alternates and changes in scope may be found in the follows:
  - 1. OUS Bid Form
  - 2. Instructions to Bidders
  - 3. OUS General Conditions
  - 4. Other Sections of these specifications.

## 1.3 DEFINITION

- A. An alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Project Manual that may be added or deducted from the Basic Bid amount if the Owner decides to accept a corresponding change in the amount of construction to be completed, or in the products, materials, equipment, systems, or installation method.
- B. The cost change for each alternate is the net addition to or deletion from the Basic Bid to incorporate the alternate into the work. No other adjustments are made to the Basic Bid, unless stipulated in the Instructions to Bidders or the OUS General Conditions for Public Improvement Contracts.

## PART 2 - PRODUCTS

NOT USED

## PART 3 - ACCEPTANCE OF ALTERNATIVES

- 3.1 The Owner's initial intent is to contract for all work of the Basic Bid. All required bonding, deposits, securities or guarantees required by the Contract Documents shall be based on the Basic Bid amount.
- 3.2 Alternates quoted on the Bid Form will be reviewed and may be rejected, accepted individually, in combination or entirely at the Owner's Option.
- 3.3 Alternates to the Basic Bid will be executed by a Change Order, in accordance with Division 1 Section 013100 and the OUS General Conditions for Public Improvement Contracts Section D.
- 3.4 Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required to complete the alternative work and surrounding modifications whether or not mentioned as part of the work.
- 3.5 Coordinate related work and modify surrounding work to integrate the work of each alternative.
- 3.6 A "Schedule of Bid Alternates" is provided at the end of this Section. Refer to other Specification Sections of this Project Manual for materials necessary to achieve the Work described under each alternate.



## PART 4 - SCHEDULE OF BID ALTERNATES

4.1 The following Alternates may be deducted and/or added from the Work of the Base Bid:

1. Deduct Alternate No.1: Waterproof Main Roof Deck and Penthouse Roofs with Hot Fluid Applied Rubberized Asphalt Waterproofing.
2. Add Alternative No. 2: Remove and Replace Indicated Roof Top Mechanical Units.
3. Add Alternative No. 3: Remove and Replace Indicated Skylights. Existing skylights A, B and C to be removed and replaced with new framing and glazing.
4. Add Alternative No. 4: Install Additional Metal Roof Access Ladder. Install new metal roof access ladder to access mechanical roof from main roof level.
5. Add Alternate No.5: Waterproof existing Sky Bridge Roofs (both enclosed and open air walkways). Remove existing roofing system, associated flashings, guardrail, insulation and ballast on two skybridge roofs that connect Neuberger Hall to adjacent building. Waterproof both skybridge roofs with fluid applied asphalt waterproofing system as indicated in documents. Provide price for both cold and hot systems. Raise curbs at upper level skybridge at guardrail, re-roof, re-install guardrail.
6. Add Alternate No.6: Remove (2) Existing Access Ladders on Exterior of Building. Repair, flash and refinish as required the old connection points on building façade.

END OF SECTION

## SECTION 01210 - ALLOWANCES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing allowances.
  - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
  - 1. Lump-sum allowances.
- C. Related Sections include the following:
  - 1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.

## 1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

## 1.4 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

## 1.5 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

## 1.6 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner under allowance and shall include taxes, freight, and delivery to Project site.
- B. Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner under allowance shall be included as part of the Contract Sum and not part of the allowance.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

## 3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

## 3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Re-burnish Existing Skylights
  1. Amount: \$25,000
  2. Allowance includes re-flashing, removing and re-sealing glazing, and other repair of existing skylights, appropriate scope to be determined within limits of allowance.
  3. Repainting existing skylight frames is to be included in the base bid and is not part of this allowance.
- B. Allowance No. 2: Miscellaneous Cast In Place Concrete Repair
  1. Amount: \$20,000
  2. Allowance includes repair of existing concrete structure and exterior penthouse walls.

END OF SECTION 012400

## SECTION 012900 - PAYMENT PROCEDURES

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. Work of this Section includes procedures for progress payments.
- B. Related work specified elsewhere:
  - 1. For the primary discussion of payments, refer to Article E of OUS General Conditions for Public Improvement Contracts and Supplemental General Condition SG-3.

## PART 2 - PRODUCTS

## 2.1 APPLICATION FORMS

- A. For applications for payment, use AIA Document G702, Application and Certificate for Payment, supported by AIA Document G702a, Continuation Sheet.
- B. Prepare the Schedule of Values in such a manner that each major item of Work and each subcontracted item of Work is shown as a line item costs broken down to correspond to the project construction schedule as detailed in Article H.2.1 of the OUS General Conditions for Public Improvement Contracts on AIA Document G702a, Application and Certification of Payment, Continuation Sheet. The Continuation Sheet shall be the minimum Schedule of Values breakdown.

## PART 3 - EXECUTION

## 3.1 PAYMENTS

- A. The Owner will make progress payments on the account of the Contract once a month, based on the value of Work accomplished or materials on the Premises, as stated in the Schedule of Values on the Application and Certificate for Payment. Complete and forward three (3) copies of the Application and Certificate for Payment to the Architect by the 20th day of each month.
- B. Payments will be made on protected materials on hand on the Premises properly stored, protected, and insured. Estimated quantities shall be subject to the Architect's review and judgment.

END OF SECTION

## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

## PART 1 - GENERAL

## 1.1 DESCRIPTION:

- A. This Section includes administrative and supervisory requirements necessary for coordinating contract documentation, communications and construction operations. The requirements of this Section relate to all work by the Contractor and Sub-contractors performing work under these Contract documents including, but not limited to, the following:

1. Pre-construction Coordination
2. Identification of Owner's Authorized Representatives
3. Identification of Architect
4. Listing of Sub-contractors
5. Contractor Emergency Contact Information
6. Safety & Emergency Procedures
7. Unforeseen Hazardous Materials
8. Permits and Fees
9. Key Requests
10. Progress Meetings
11. Requests for Clarifications & Information
12. Construction Directives
13. Construction Change Orders

## 1.2 RELATED WORK IN OTHER SECTIONS:

- A. Additional requirements related to Project Coordination may be found in the following:
1. Instructions to Bidders
  2. OUS General Conditions
  3. Other Sections of these specifications.

## PART 2 - PRODUCTS

NOT USED

## PART 3 - EXECUTION

## 3.1 PRE-CONSTRUCTION CONFERENCE

- A. A pre-construction conference shall predate the Work and shall include but not be limited to the following agenda:
1. Contract management and communication requirements
  2. Emergency phone numbers
  2. Record maintenance requirements
  3. Work schedule
  4. Schedule of values
  5. Submittal schedule
  6. Early purchase, long lead items and owner procurements
  7. Multiple contract coordination
  8. Maintenance of access and use of the premises
  9. Traffic control, parking and contractor's use of the job site

10. Hazardous materials
  11. Job site safety
  12. Job site inspection & observation requirements
  13. Review of contract documents
  14. Progress meetings
  15. other subjects of interest desired by the Contractor, Architect, Owner's Authorized Representative(s), Manufacturer's Representatives, and other participants.
- B. Refer to Division 1, Section 013300 for submittals required prior to the pre-construction conference.
- C. Coordinate all operations with the Owner's Authorized Representative during the construction period.
- D. Submit to the Owner's Authorized Representative for approval, a schedule of Values for the Work to be performed; schedule of values shall include project and building name, when the Work is to begin, and estimated duration of the Work. The Schedule of Values is to be provided to the Owner's Authorized Representative in accordance with OUS Supplemental General Condition SG-3.
- E. Submit to the Owner's Authorized Representative for approval, a schedule for the Work to be performed; schedule shall include project and building name, when the Work is to begin, and estimated duration of the Work. The Schedule is to be provided to the Owner's Authorized Representative in accordance with OUS Supplemental General Condition SG-5. The schedule shall be specific as to which portion of the Work is taking place on a particular day.
- F. Prior to start of any work, Contractor shall provide at the pre-construction meeting an emergency responsible person/contact list on a 24-hour, "7 day a week" basis for any emergency issue that may arise in connection with this project. Contractor must reissue the list any time the responsible person(s) changes. Issue to Owner's Authorized Representative. See Project Information Sheet provided herein.
- G. Parking will not be provided on the premises. See Section 015000 Temporary Facilities.
- H. Schedule elevator usage with the Owner's Representative a minimum of 72 hours in advance so as not to inconvenience the public.

### 3.2 IDENTIFICATION OF OWNER'S AUTHORIZED REPRESENTATIVE

- A. The Owner's Project Manager and the Owner's Field Construction Manager (Jointly the Owner's Authorized Representative or his designee) will be appointed by the Owner and identified at the Pre-construction meeting. The Owner's Authorized Representative in conjunction with the Architect will provide coordination during construction and on-site observation. See Project Information Sheet provided herein.

### 3.3 IDENTIFICATION OF ARCHITECT

- A. The Owner has contracted with Carleton Hart Architecture to prepare construction documents and assist in Owner's Authorized Representative in the coordination of the construction project. See Project Information Sheet provided herein.

### 3.4 LISTING OF SUB-CONTRACTORS

- A. Provide to the Owner's Authorized Representative at the pre-construction conference three (3) copies of list of sub-contractors anticipated to perform work on the project. Provide on the list of sub-contractor's: subcontractor's name, contact person, mailing address and telephone number. Substitution shall be permitted only with the approval of the Owner's Authorized Representative.

### 3.5 CONTRACTOR EMERGENCY CONTACT INFORMATION

- A. Provide to the Owner's Authorized Representative at the pre-construction conference Contractor Emergency Contact telephone numbers. See Project Information Sheet provided herein.

### 3.6 SAFETY AND EMERGENCY PROCEDURES

- A. The Contractor shall be responsible for maintaining a safe job site at all time, until the Owner takes possession. The Contractor shall comply with all safety regulations, and for enforcing compliance with all safety regulations and procedures by all workers, sub-contractors and visitors on the site.
- B. Refer to Division 1, Section 015000 for minimal temporary facilities required for job site safety. The Contractor shall provide procedures and additional temporary facilities as required.
- C. The Contractor shall maintain indoor air quality and noise control standards specified in Division 1, Section 017500
- D. The Contractor shall complete and submit the Owner's Authorized Representative, at the pre-construction conference the "Construction Project Safety Form" provided herein.

### 3.7 UNFORESEEN HAZARDOUS MATERIAL

- A. Asbestos: The Owner has exercised due diligence in the identification and removal of asbestos containing materials from the work area. Prior to each phase of construction the Contractor shall confirm the non-existence of asbestos containing materials in the work area prior to proceeding. If the Contractor identifies materials suspected of containing asbestos, he shall immediately stop work in that area of the job site and proceed in accordance with Division 1, Section 017419, Item 3.1(F).
- B. Lead Paint: The Owner has exercised due diligence in the identification and removal of lead paint from the work area. Prior to each phase of construction the Contractor shall confirm the non-existence of materials coated with lead based paint in the work area prior to proceeding, as required in accordance with OSHA Directive CPL 2-2.58. If lead based paint materials are suspected, the contractor shall immediately notify the Owner's Authorized Representative and proceed in accordance with OSHA Standards and Directives. If required an adjustment in the Contract Sum and Contract Time will be made through Execution of a Contract Change Order in Accordance with OUS General Conditions for Public Improvement Contracts Section D.1.3(c).

### 3.8 PERMITS & FEES

- A. The Neuberger Hall is enrolled in the city of Portland's Facilities Permit Program. See OUS Standard General Conditions and Supplementary General Conditions.
- B. The Owner shall provide Building, Electrical, Mechanical and Plumbing permits for buildings in accordance with OUS Supplemental Condition SG-2. If the Contractor needs to block a portion of the right-of-way, the Contractor must secure the proper permits from the City of Portland and shall give all requisite notices to public authorities. The Contractor shall be responsible for all violations of the law for any cause in connection with the Work or caused by obstructing streets or sidewalks.

- C. The Contractor shall provide proper notice to all governing jurisdictions including but not limited to the Oregon Department of Environmental Quality prior to beginning work.
- D. Contractor shall pay for and document Oregon Bureau of Labor and Industries fees as required by Bureau of Labor & Industry.

### 3.9 KEY REQUESTS

- A. Keys will be provided to the Contractor as required for access to buildings and work areas. There is a deposit of \$100.00 required for each key given to the Contractor. Contractor shall fill out Contractor's key request form and deliver for approval to Project Manager a minimum of 48 hours in advance. This deposit will be refunded upon return of the key(s.) Keys will not be provided to sub-contractors, nor will Facilities open locked doors for Contractor's employees or sub-contractors. Contractor shall provide and coordinate all such requirements.

### 3.10 PROGRESS MEETINGS

- A. The contractor shall schedule for the contractor's Project Manager and Field Superintendent to attend weekly Progress Meetings with the Architect and the Owner's Authorized Representative. The contractor shall coordinate and assure the attendance of sub-contractors as required by the agenda and the Owner's Authorized Representative.
- B. Weekly Progress Meetings shall be held each(day and time), following the pre-construction conference and continuing through substantial completion and until final completion. The Owner's Authorized Representative may require additional on-site 'tail-gate' meetings as necessary to resolve construction related issues and facilitate continued progress.
- C. Progress meetings shall be held at:
  - PSU, Office of Facilities
  - 202 University Services Building
  - 617 SW Montgomery
- D. The progress meeting minutes serve as the official communication between all parties involved in the Project. The Contractor shall:
  - 1. Prepare agendas.
  - 2. Record minutes and include decisions.
  - 3. Record attendance
  - 4. Distribute minutes to attendees within three (3) calendar days after meetings.
- E. Minimum agenda shall include:
  - 1. Review and approve minutes of previous meetings.
  - 2. Review work progress and work schedule since previous meeting.
  - 3. Discuss field observations, problems, clarifications and information required.
  - 4. Review delivery schedules, identify problems that could impede planned progress.
  - 5. Review proposed changes in construction or procedures.
  - 6. Delivery and discussion of submittals.
  - 7. Submittal of progress payment requests for review.
  - 8. Other items as may be required.

### 3.11 REQUESTS FOR CLARIFICATIONS AND INFORMATION



- A. Throughout the course of work, the Contractor may require clarifications or additional information from the Architect or Owner's Authorized Representative. This information may include but not be limited to the following:
1. Clarifications whether specific work is within the scope of an item of work and no Contract adjustment is anticipated.
  2. Clarifications or interpretations of information or directions provided in the Contact Documents, for which no Contract adjustment is anticipated.
  3. Clarifications or directions as a result of unforeseen conditions, which may or may not result in adjustments to the Contact Sum or days allowed for contact completion.
  4. Additional details or information needed for construction, which were not originally included in the contract documents, which may or may not result in adjustments to the Contact Sum or days allowed for contact completion.
- B. The contractor's field superintendent shall be the principle generator of requests for clarification and information (RFI's) as a result of field operations and conditions.
- C. Three copies of requests for clarifications and information (RFI) shall be typed and submitted in accordance with the communication process described in Section 013300.
- D. All RFI's shall be sequentially numbered and include the following information:
1. Project item information as specified in Section 013300, Item 1.5.
  2. Reason for request, and clarification and information requested.
  3. Work impacted by request for clarification or information.
  4. Drawings or sketches as necessary.
  5. Contractors recommendations as appropriate.
  6. Signature and date by contractor's authorized representative.
- E. If the contractor anticipates that a change in the scope of work may be necessary in conjunction with a request for clarification or information, he may submit with the request a proposal to perform additional work as a Contract Change Order as specified herein. No changes in work shall commence without an approved RFI response, Construction Directive or Executed Contract Change Order.
- F. All RFI Responses will be by the Architect through and with the approval of the Owner's Authorized Representative.
- G. Response time to process RFI's shall be seven (7) calendar days from the date received by the Architect, to allow reasonable time for researching the question and preparing a response. If, due to unavoidable circumstances, information is needed immediately, coordinate with the Owner's Authorized Representative who will attempt to expedite a response by FAX or e-mail. When responses are expedited, an RFI must still be submitted as a confirmation of the communication prior to submitting for progress payment for the related work.
- H. A log and copies of all RFI's shall be maintained in the jobsite office, for review or reference by the Contractor, Architect and Owner's Authorized Representative.

### 3.12 CONSTRUCTION DIRECTIVES

- A. Construction Directives may be initiated by the Owner's Authorized Representative, or the Architect on approval of the Owner's Authorized representative, and provides interpretations of the contract documents or orders minor changes in the work, which may require changes in the

Contract Sum or Contract Time, which would be subsequently executed through a Construction Change Order. Interpretation of the Contract documents shall be in accordance with OUS General conditions for Public Improvement Contracts Section A.3, and as amended by the OUS Supplemental General Conditions. Construction Directives are not Construction Change Orders. If the Contractor believes the work described in a Construction Directive requires a change in Contract Sum or Contract Time, he shall submit a proposal to perform additional work as a Construction Change Order as specified herein. Do not proceed with Construction Order work until a proposal for Change Order work has been submitted and directed to proceed by the Owner's Authorized Representative. Proceeding without authorization waives the Contractor's claim for additional Contract Sum or Contract Time.

- B. Construction Directives shall be executed using the attached Construction Directive form.

### 3.13 CONSTRUCTION CHANGE ORDERS

- A. Contract Bid award is based on the Base Bid. Additional work may be authorized by amending the Contract based upon Unit Prices provided in the Bid Form, the Contractor's Schedule of Values, or other Contractor Proposals approved by the Owner's Authorized Representative, and in accordance with Section D of the OUS General Conditions for Public Improvement Contracts.
- B. A Construction Change Order is a written order issued after the execution of a contract, which authorizes and directs a change in scope of work and an adjustment in the Contract Sum, Contract Time or both. Change Orders will be processed using AIA Document 701, and is not complete until all signatures have been obtained and a signed copy is received by the Contractor.
- C. A Contract Change Order request can be initiated by the Owner's Authorized Representative through a proposal request to the Contractor, or by the Contractor through submittal of a proposal request in conjunction with a RFI response or Construction Directive.
- D. The Contractor's proposal for Contract Change Order Work shall include the following:
1. Project item information as specified in Section 013300, Item 1.5.
  2. Reason for request
  3. Itemized statement of required materials and equipment, including adjustments to adjacent and dependent work.
  4. Itemized statement of required labor, including adjustments to adjacent and dependent work.
  5. Total Contract Sum adjustment required for the Change in Work.
  6. Total Contract Time adjustment required for the Change in Work.
  7. Additional Documentation as required to support the request.
  8. Signature and date by contractor's authorized representative.
- E. Construction Change Order work shall be reviewed by the Architect and the Owner's Authorized Representative and executed in accordance with OUS General conditions for Public Improvement Contracts Section D, and as amended herein.
- F. If a fair and reasonable Contract Change Order adjustment cannot be agreed upon, the Owner's Authorized Representative may in writing direct the Contractor to proceed with the Change in Work on a 'Time and Materials' basis in accordance with OUS General Conditions for Public Improvement Contracts.

END OF SECTION

PORTLAND STATE UNIVERSITY  
OFFICE OF FACILITIES  
PROJECT INFORMATION

**Project Name:** PSU Neuberger Hall Roof Maintenance      **Project No:** TBD

**Project Description:** Reroof with alternates to replace mechanical units and skylights.

**Project Address:** 724 SW Harrison Street      **Work Start Date:** TDB

**Project Manager:** Francis McBride      **Phone:** (503) 725-8944      **FAX:**

**Project Site Construction Manager:** Francis McBride      **Phone:** (503) 725-8944

**Design Consultant:** Carleton Hart Architecture      **Phone:** 503-206-3181

**Address:** 322 NW 8<sup>th</sup> Avenue, Portland, Oregon

**E-Mail :** scott.palmer@carletonhart.com      **FAX:** 503-243-3261

**Bid Opening Date:**      **Contract Bid Price:**

**Contract Execution Date:**      **Pre-Const. Meeting:**

**Notice to Proceed Date:**      **Contract Calendar Days:**

**Final Contract Completion Date:**      **Liquidated Damages:**

**Contractor Name:**      **Office Phone:**

**Project Manager:**      **Cell:**      **Pager:**

**Contractor Office Address:**

**E-Mail:**      **Office FAX:**

**On Site Construction Office Address:**      **Site Phone:**

**Site E-Mail:**      **Site FAX:**

**Site Superintendent:**      **Cell:**      **Pager:**

**Contractor's Emergency & Weekend Phone:**

1.      2.      3.

PORTLAND STATE UNIVERSITY  
OFFICE OF FACILITIES  
CONSTRUCTION PROJECT SAFETY FORM INSTRUCTIONS

The purpose of the Construction Project Safety Form is to allow contractors to plan the construction or remodeling project in such a way as to prevent injuries and protect the environment. **This form will need to be filled out by the Contractor and provided to the Owner's Authorized Representative at the preconstruction conference.**

**The information provided on the form will be reviewed at the preconstruction conference.**

All projects must be planned with safety consideration for people who will be in contact with the area; in particular, sight, hearing, or mobility impaired people who are not covered under OSHA regulations but are covered under general liability issues.

PSU requires that all contractors and subcontractors come to the job trained in all Occupational Safety and Health ACT (OSHA) Standards applicable to their work process. This information is outlined in the OR-OSHA document "Occupational Hazards Common to Construction & Remodeling Activities." This document can be obtained free of charge by contacting the OR-OSHA Resource Center at 1-800-922-2689 or on-line at [www.ROSHA.org](http://www.ROSHA.org).

All construction and remodeling activities regardless of size and/or scope must be fenced, barricaded, or otherwise protected (isolated) to restrict entrance and to ensure the safety of those in the general area. **All building materials and equipment need to be placed within the isolation enclosure.** Any open trenches outside the isolated space will need to be fenced or covered with approved cover (contact the Owner's Authorized Representative for specifics).

**REQUIRED PROJECT ISOLATION AND BARRICADING OPEN TRENCHES FOR OUTSIDE CONSTRUCTION SITES**

Construction projects that involve building a facility, any exterior remodel, any excavation, or demolition, at a minimum, will install the following perimeter isolation:

*A six foot chain-link fence, with controlled access points, extending in all directions around the excavation or building site such that no area of the construction is accessible to pedestrians or unauthorized personnel or vehicles. Note: At the University's option, other barricading plans may be accepted. These may apply to projects such as road resurfacing, parking lot striping, exterior building water proofing, etc. Typical temporary construction fencing shall be covered with opaque material to prevent seeing inside the fencing. Construction fencing shall be placed on the interior side of the opaque material.  
Also see Section 015700(Contractor Staging)*

Indoor projects which will create dust (cutting sheetrock, sanding, sawing etc.) are subject to the following:

1. Areas where existing doors can provide isolation will be labeled "Construction Area Authorized Personnel Only."
2. All other areas will be isolated by a solid barrier. The minimum barrier allowed is 4 mil poly sheeting.

**Any excavation across or adjacent to sidewalks or pathways which must be left open overnight, must be identified with working, blinking, construction lights in addition to being covered.**

**The contractor will provide all trench covering and fencing material, PSU will not provide any materials.**

Portland State University  
OFFICE OF FACILITIES  
CONSTRUCTION PROJECT SAFETY FORM

Complete and deliver with the Project Information sheet to the Owner's Authorized Representative at the Pre-Construction Conference.

Meeting Date: \_\_\_\_\_ Time: \_\_\_\_\_ Location: \_\_\_\_\_

Project: \_\_\_\_\_ Job #: \_\_\_\_\_

Contractor: \_\_\_\_\_ Start: \_\_\_\_\_ Completion: \_\_\_\_\_

Contractor Foreman: \_\_\_\_\_

PSU Project Mgr: \_\_\_\_\_

Emergency Fire/Medical.Security #: 911 Non-Emergency Campus Safety (503) 725-4407

Confined Space to be accessed? Y or N Location: \_\_\_\_\_

If yes, review confined space program with PSU Project Manager

Welding or hot work to be done? Y or N If yes, describe extinguisher, and fire watch, plan:

\_\_\_\_\_

MSDS copies to be on the job site and copies available to PSU Project Manager.

Lead paint involved? Y or N Contact PSU Health and Safety Supervisor (503) 725-8458

Describe hazard mitigation plan: \_\_\_\_\_

\_\_\_\_\_

Asbestos involved? Y or N If yes, Contact PSU Health and Safety Supervisor (503) 725-8458

Hazard Waste Plan developed? Y or N Containers: \_\_\_\_\_

Storage Loc: \_\_\_\_\_

\_\_\_\_\_

In the event of suspected hazardous materials or spill contact PSU Health and Safety Supervisor (503) 725-8458or Cell # (503) 888-0189.

Describe hazmat spill plan: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Will there be any open trenches or holes? Y or N Describe plan to barricade: \_\_\_\_\_

\_\_\_\_\_

Internal combustion engines? Y or N If yes, is CO monitoring required? Y N

Other air contaminates? Y or N If yes, describe: \_\_\_\_\_

Building air intake & return air locations: \_\_\_\_\_

**(No chemical compounds to be used near functioning intake or return air locations.)**

Material deliver or parking creating hazard? Y or N If yes, describe minimization plan: \_\_\_\_\_

**No vehicle is allowed to park on sidewalk entrances/exits to steam tunnel (metal hatch cover).**

Dust created? Y or N If yes, describe control plan: \_\_\_\_\_

Noise sources? List: \_\_\_\_\_

Describe noise control methods: \_\_\_\_\_

Crane to be used? Y or N If yes, describe plan: \_\_\_\_\_

(Loads will not be moved over or suspended above pedestrian occupied areas)

Exterior chute to be used? Y or N If yes describe plan: \_\_\_\_\_

Construction area to be fenced? Y or N Type & location: \_\_\_\_\_

Fence to be locked? Y or N Job Trailer on site? Y or N To be locked? Y or N All contractor lock keys to Security Services dispatch and PSU Project Manager

Building exitways to be blocked or restricted at any time? Y or N If yes, describe ADA alternate routes and overall egress plan: \_\_\_\_\_

Will project create interior hazards to building occupants? Y or N If yes, describe hazards and minimization plan: \_\_\_\_\_

Lock changes planned? Y or N If yes, describe location and responsible party: \_\_\_\_\_

END OF PROJECT SAFETY FORM

PORTLAND STATE UNIVERSITY  
**OFFICE OF FACILITIES**  
REQUEST FOR INFORMATION

Project: \_\_\_\_\_ RFI No.: \_\_\_\_\_

Contractor: \_\_\_\_\_ Date submitted: \_\_\_\_\_

Subcontractor: \_\_\_\_\_ Date info req'd: \_\_\_\_\_

Supplier: \_\_\_\_\_

Provide all information required by Specification Division I Section 013100. Attach additional sheets as required.

Request:

Contractor \_\_\_\_\_ Date \_\_\_\_\_

Response:

Architect \_\_\_\_\_ Date \_\_\_\_\_

Acknowledgement by Owner's Rep. \_\_\_\_\_ Date \_\_\_\_\_

PORTLAND STATE UNIVERSITY  
OFFICE OF FACILITIES  
CONSTRUCTION DIRECTIVE

Project: \_\_\_\_\_ Directive No.: \_\_\_\_\_

Contractor: \_\_\_\_\_ Date submitted: \_\_\_\_\_

Subcontractor: \_\_\_\_\_ Date info req'd: \_\_\_\_\_

Supplier: \_\_\_\_\_

You are hereby directed to execute promptly this Directive which interprets the Contract Documents or orders minor changes in the work. If you consider that a change in Contract Sum or Contract Time is required, submit an itemized change order proposal as required by Specification Division I Section 013100. If your proposal is in order, this Directive will be superseded by a Change Order.



Description:

Architect: \_\_\_\_\_ Date: \_\_\_\_\_

Owner's Authorized Rep: \_\_\_\_\_ Date: \_\_\_\_\_



## SECTION 013300 - SUBMITTAL PROCEDURES

## PART 1 - GENERAL

## 1.1 DESCRIPTION:

- A. The requirements specified in this Section relate to Submittal materials, Requests for Information and Requests for Clarification by all Contractors, Sub-contractors and Suppliers performing Work under these Contract Documents and includes:

1. Submittal Procedures
2. Submittals Schedule
3. Proposed Products List
4. Shop Drawings
5. Product Data
6. Samples
7. Manufacturer's Instructions
8. Manufacturer's Operations & Maintenance Manuals
9. Manufacturer's Certificates

## 1.2 RELATED WORK IN OTHER SECTIONS:

- A. Additional submittal requirements may be provided as follows:

1. Instructions to Bidders
2. OUS General Conditions
3. Supplemental General Conditions
4. Other Sections of these specifications.

- 1.3 All Submittals, Shop Drawings, Product Data and Samples shall be in accordance with OUS General Conditions for Public Improvement Contracts Section B.18 as amended by the Supplemental General Conditions and as specified herein.

- 1.4 Transmit six (6) copies of each submittal with sequentially numbered forms. Provide two (2) additional copies when submittal involves mechanical or electrical review. Re-submittals shall have original number and alphabetic prefix.

- 1.5 Identify Project, Contractor, Subcontractor and supplier; pertinent drawing sheet and detail number(s), and specification numbers, as appropriate.

- 1.6 Review of the submittals by the Architect and Owner's Authorized Representative shall not relieve the Contractor of its obligations as specified in OUS General Conditions for Public Improvement Contracts Section B.18.

- 1.7 The General Contractor shall sign certifying that review, verification of products required, field dimensions, adjacent construction work and coordination of information, is in accordance with the work of the Contract Documents.

- 1.8 Provide space for review approval by Architect and the Owner's Authorized Representative, as specified herein.

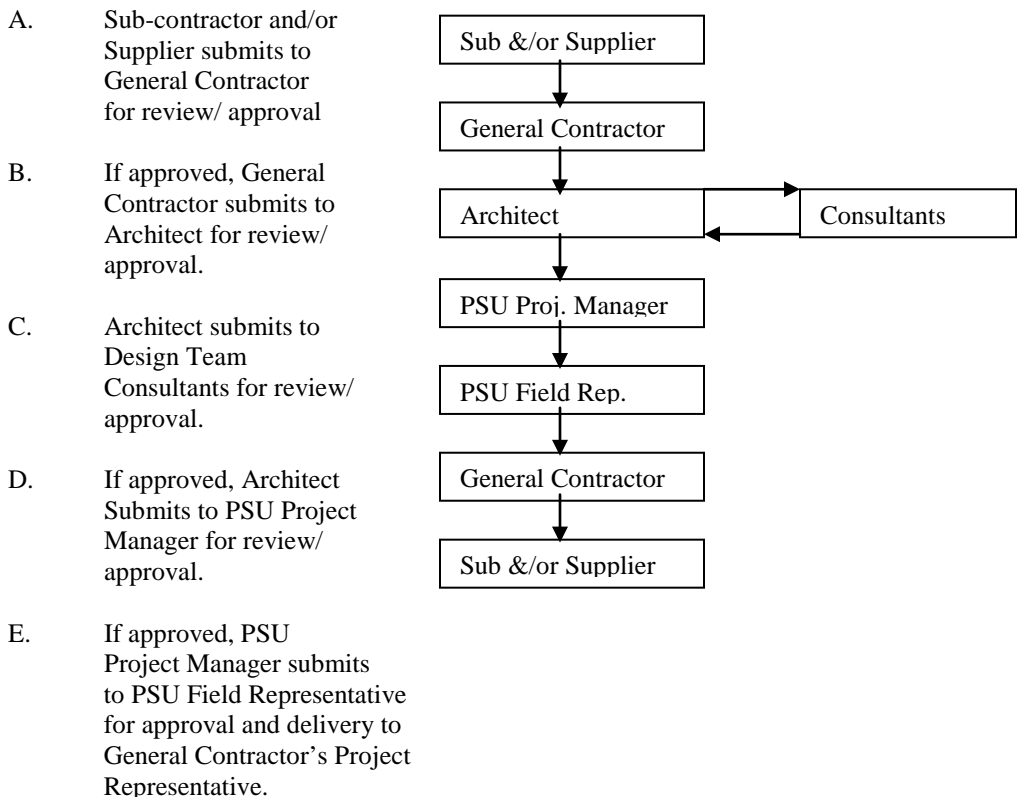
- 1.9 Schedule submittals to expedite Project; deliver to Architect and Owner's Authorized Representative as directed herein and coordinate submission of related items.

PART 2 - SUBSEQUENT TO THE AWARD OF THE CONTRACT

- 2.1 Seventy-two (72) hours prior to the pre-construction conference and in all cases prior to the commencement of work, the Contractor shall submit the following to the Owner’s Authorized Representative:
  - A. Certificate of Insurance as required.
  - B. Signed Public Improvement Agreement.
  - C. Five (5) original copies of Performance & Payment Bonds.
  - D. Schedule of Values.
  - E. Project Construction Schedule.
  - F. Submittal List and Schedule of Submittals, identifying long lead items.
  - G. Contractor Emergency Contact Information.
  
- 2.2 Prepare Schedule of Submittals in chronological order by date of required submittal approval. Indicate the following:
  - A. Category of submittal.
  - B. Name of sub-contractor or supplier.
  - C. Generic Description of Work covered.
  - D. Related Specification Section Number.
  - E. Activity or event number on the project construction schedule.
  - F. Proposed submittal date for first submittal.
  - G. Date material required for installation.
  - H. Re-submittal dates and final release or approval by Architect and Owner’s Authorized Representative.

PART 3 - DURING CONSTRUCTION

3.1 The general Submittal Review Procedure is illustrated in the following diagram.



- 3.2 Allow fourteen (14) calendar days for submittal review by Architect and Owner's Authorized Representative. Allow (3) additional calendar days for mechanical and electrical reviews. The General Contractor shall be responsible for timely the submittal of materials approvals in order to satisfy required delivery dates and maintain the construction schedule.
- 3.3 ACTION BY ARCHITECT AND OWNER'S REPRESENTATIVE
- A. Except for submittals for the record or information, where action and return is required, the Architect will review each submittal, mark to indicate action taken, and return promptly through and with approval of the Owner's Authorized Representative. All unacceptable or rejected submittals shall be immediately corrected and resubmitted for review.
1. Compliance with specified characteristics is the Contractor's responsibility.
- B. Action Stamp: The Architect will stamp each submittal with a uniform action stamp. The Architect will mark the stamp appropriately to indicate the action taken, as follows:
1. Final Unrestricted Release: When the Architect marks a submittal "No Exceptions Taken," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents.
  2. Final-But-Restricted Release: When the Architect marks a submittal "Make Corrections Noted," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents.
  3. Returned for Resubmittal: When the Architect marks a submittal "Revise and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
  4. Unsolicited Submittals: The Architect will return unsolicited submittals to the sender without action.
- 3.4 The Owner's Representative may request additional information during the course of the project to monitor material and equipment deliveries as well as coordinate work and materials by others. The General Contractor may be required to submit and periodically update a Material Delivery Summary indicating material order dates, purchase order numbers, expected delivery dates and actual delivery dates.
- 3.5 SHOP DRAWINGS
- A. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents as the basis of Shop Drawings.
- B. Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include the following information:
1. Dimensions.
  2. Identification of products and materials included by sheet and detail number.
  3. Compliance with specified standards.
  4. Notation of coordination requirements.
  5. Notation of dimensions established by field measurement.
  6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least **8-1/2 by 11 inches** but no larger than **30 by 42 inches**.
  7. Do not use Shop Drawings without an appropriate final stamp indicating action taken.
- C. Subsequent to Substantial Completion and prior to Final Pay Request, Submit five (5) copies of As Built documentation of all shop drawings to the Architect for inclusion in Project Record Documents. See OUS General Conditions for Public Improvement Contracts Section K and Division 1 Section 017700 for Project Closeout requirements.

### 3.6 PRODUCT DATA

- A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.
1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:
    - a. Manufacturer's printed recommendations.
    - b. Compliance with trade association standards.
    - c. Compliance with recognized testing agency standards.
    - d. Notation of dimensions verified by field measurement.
    - e. Notation of coordination requirements.
  2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
  3. Submittals: Submit 6 copies of each required submittal; submit 2 additional copies where review is required by Architect's consultants. Up to four copies will be retained by Architect and Owner, plus copies by Architect's consultant, the remaining copies will be returned marked with action taken and corrections or modifications required.
  4. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities.
    - a. Do not proceed with installation until a copy of Product Data is in the Installer's possession.
    - b. Do not permit use of unmarked copies of Product Data in connection with construction.

### 3.7 SAMPLES

- A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.
1. Mount or display Samples in the manner to facilitate review of qualities indicated. Prepare Samples to match the Architect's sample. Include the following:
    - a. Specification Section number and reference.
    - b. Product name or name of the manufacturer.
    - c. Compliance with recognized standards.
  2. Submit Samples for review of size, kind, color, pattern, and texture. Submit Samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
    - a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least 3 multiple units that show approximate limits of the variations.
    - b. Samples not incorporated into the Work, or otherwise designated as the Owner's property, are the property of the Contractor and shall be removed from the site prior to Substantial Completion.

3. Submittals: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation, and similar characteristics, submit three sets. The Architect will return two sets marked with the action taken.
4. Maintain sets of Samples, as returned, at the Project Site, for quality comparisons throughout the course of construction.
  - a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
  - b. Sample sets may be used to obtain final acceptance of the construction associated with each set.
  - c. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the Work.

### 3.8 QUALITY ASSURANCE SUBMITTALS

- A. Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.
- B. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements.
  1. Signature: Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.
- C. Inspection and Test Reports: Requirements for submittal of inspection and test reports from independent testing agencies are specified in Division 1 Section "Quality Control."

### 3.9 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual Specification Sections, submit manufacturer's printed instructions for delivery, storage, assembly, start-up, testing, adjusting and finishing.
- B. Submit any conflicts between the manufacturer's instructions and the Contract Documents for clarification by the Architect and Owner's Authorized Representative.

### 3.10 MANUFACTURER'S CERTIFICATE

- A. When specified in individual Specification Sections, submit manufacturer's certificate for review, in quantities specified.
- B. Indicate material or product conforms to or exceeds specific requirements. Submit supporting reference data, affidavits, and certificates as appropriate.
- C. Certificates may be recent or previous test results on materials or products, but must be acceptable to the Architect and the Owner's Authorized Representative.

PRODUCTS (Not Applicable)

EXECUTION (Not Applicable)

END OF SECTION

## SECTION 014000 - QUALITY REQUIREMENTS

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. The requirements specified in this Section relate to general quality control of the Project and supplement the quality control requirements specified in the OUS General Conditions for Public Improvement Contracts and other Sections of these Specifications. The requirements of this Section relate to all work performed by all Contractors and Sub-contractors performing work under these Contract Documents and include:

1. References and standards.
2. Quality assurance submittals.
3. Mock-ups.
4. Control of installation.
5. Tolerances.
6. Testing and inspection services.
7. Manufacturers' field services.

## 1.2 RELATED SECTIONS

- A. Additional requirements related to Quality Requirements may be provided as follows:

1. OUS General Conditions
2. Other Sections of the specifications.

## 1.3 REFERENCES

- A. ASTM C 1021 -Standard Practice for Laboratories Engaged in Testing of Building Sealants; 1997.
- B. ASTM C 1077 -Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2000.
- C. ASTM C 1093 -Standard Practice for Accreditation of Testing Agencies for Unit Masonry; 1995.
- D. ASTM D 3740 -Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 1999c.
- E. ASTM E 329 -Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction; 2000b.
- F.
- G. ASTM E 543 – Standard Practice for Agencies Performing Nondestructive Testing; 1999.
- H. ASTM E 548 – Standard Guide for General Criteria used for Evaluating Laboratory Competence; 1994.

## 1.4 SUBMITTALS

- A. Testing Agency Qualifications:

1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
  2. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- B. Design Data: Submit for Architect's knowledge as contract administrator or for the Owner, for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
- C. Test Reports: After each test/inspection, promptly submit two copies of the report to the Contractor and additional copies to the Architect and Owner's Authorized Representative for processing through the procedure specified in Section 013100. All test reports shall include the following information:
1. Date issued.
  2. Project title and number.
  3. Name of inspector.
  4. Date and time of sampling or inspection.
  5. Identification of product and specifications section.
  6. Location In the Project.
  7. Type of test/inspection.
  8. Date of test/inspection.
  9. Results of test/inspection.
  10. Conformance with Contract Documents.
  11. When requested by Architect, provide interpretation of results.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect and Owner's Authorized Representative, in accordance with the procedure specified in Section 013100. All certificates shall include the following information:
1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
  2. Certificates may be recent or previous test results on material or product, but must be acceptable to the Architect and Owner.
- 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 review by Architect and Owner's Authorized Representative.
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 review and approval by Architect and Owner's Authorized Representative, in accordance with the procedure specified in Section 013100.
1. Submit information for the limited purpose of assessing quality control, and conformance with the design concept and contract documents.

### 1.5 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.

### 1.6 TESTING AND INSPECTION AGENCIES

- A. Unless otherwise directed in writing by the Owner's Authorized Representative, the Contractor shall make arrangements for all required testing and inspections in accordance with OUS General Conditions for Public Improvement Contracts Section B.7.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Employed Agency shall comply with the following criteria:
  - 1. Testing agency: Comply with requirements of ASTM E 329, ASTM E 548, ASTM E 543, ASTM C 1021, ASTM C 1077, and ASTM C 1093.
  - 2. Inspection agency: Comply with requirements of ASTM 03740, ASTM E329, and ASTM E548.
  - 3. Laboratory: Authorized to operate in State in which Project is located.
  - 4. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
  - 5. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

## PART 2 - PRODUCTS

NOT USED

## PART 3 - EXECUTION

### 3.1 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.

### 3.2 MOCK-UPS

- A. When required by other Sections of these specifications or the Architect provide mock-ups for review of conformance with quality, performance and design intent.
- B. Review of mock-ups will 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, remove mock-up and clear area when directed to do so.

### 3.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. 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.

### 3.4 TESTING AND INSPECTION

- A. See individual specification sections for testing required.
- B. Testing Agency Duties:
  - 1. Test samples of mixes submitted by Contractor.
  - 2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 3. Perform specified sampling and testing of products in accordance with specified standards.
  - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  - 5. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
  - 6. Perform additional tests and inspections required by Architect or Owner's Authorized Representative.
  - 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 the 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 which 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:
  4. To provide access to Work to be tested/inspected.
  5. To obtain and handle samples at the site or at source of Products to be tested/inspected.
  6. To facilitate tests/inspections.
  7. To provide storage and curing of test samples.
  8. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
  9. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
  10. 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. Payment for re-testing will be charged to the Contractor by deducting testing charges from the Contract Price.

### 3.5 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, as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect and Owner's Authorized Representative 30 days in advance of required observations.
1. Observer subject to approval of Architect.
  2. 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.

### 3.6 DEFECT ASSESSMENT

- A. Immediately replace Work or portions of the Work not conforming to the Contract Documents at no additional cost to the Owner.

END OF SECTION

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

## PART 1 - GENERAL

## 1.1 DESCRIPTION:

- A. The requirements specified in this Section relate to Temporary Facilities, Controls, Utilities and procedures required by all Sub-contractors through the General Contractor performing work under these Contract Documents and includes:
1. General Requirements for Temporary Facilities and Controls.
  2. Temporary Utilities.
  3. Temporary Electricity.
  4. Temporary Lighting.
  5. Temporary Heat.
  6. Temporary Ventilation.
  7. Temporary Telephone and Fax.
  8. Temporary Water Service.
  9. Temporary Sanitary Facilities.
  10. Temporary Fire Protection and Detection.
  11. Temporary Construction.
  12. Temporary Controls.
  13. Tree and Plant Protection.
  14. Security.
  15. Traffic Regulation and Parking.
  16. Project Identification.
  17. Field Office.
  18. Progress Cleaning
  19. Removal of Utilities, Facilities and Controls

## 1.2 RELATED WORK IN OTHER SECTIONS:

- A. Additional requirements related Temporary Facilities and Controls may be provided as follows:
1. OUS General Conditions
  2. Supplemental General Conditions
  3. Other Sections of these specifications.

## 1.3 GENERAL TEMPORARY FACILITIES AND CONTROL REQUIREMENTS

- A. This section specifies requirements for temporary services and facilities, including such items as temporary utility services, temporary construction and support facilities, temporary controls, traffic regulations, project security and protection.
- B. Cost or usage charges for temporary services or facilities are NOT chargeable to Owner, and will NOT be considered as basis for claim for change orders.
- C. Temporary utility services required for use at the Project Site include but are not limited to the following:
1. Water service and distribution.
  2. Temporary electric power and lighting.
  3. Telephone, Fax and e-mail service.

- D. Temporary construction and support facilities required for Project include but are not limited to the following:
1. Temporary heat.
  2. Temporary ventilation.
  3. Sanitary facilities.
  4. Waste disposal service.
  5. Construction aids and miscellaneous general services and facilities.
  6. Temporary enclosures.
  7. Project identification, bulletin boards and signs.
  8. Field office.
  9. Parking
- E. Security and protection facilities and services required for Project include but are not limited to the following:
1. Temporary fire protection.
  2. Barricades, warning signs and lights.
  3. Environmental protection.
- F. Comply with requirements of local laws and regulations as well as Owner's requirements governing construction, and local industry standards, in installation and maintenance of temporary services and facilities, including but not limited to the following:
1. Building codes, including local requirements for permits, testing and inspection.
  2. Health and safety regulations.
  3. Utility company regulations and recommendations for temporary services.
  4. Police and Fire Department rules and recommendations.
  5. Environmental Protection Agency regulations and requirements.
  6. Hazardous Materials Safety Regulations.
- G. Comply with requirements of NFPA Code 241, "Standards for Safeguarding Building Construction and Demolition Operations" and ANSI -A 10 Series standards for "safety Requirements for Construction and Demolition" and AGC/ASA/ASC Joint Guideline #5, "Temporary Job Utility and Services". Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services" as prepared jointly by AGC and ASC for industry recommendations
- H. Inspect and test each service before placing temporary utilities in use. Arrange for required inspections and tests by governing authorities, and obtain required certifications and permits for use.
- I. During progress of Work, submit copies of reports and permits required by governing authorities, or necessary for installation and efficient operation of temporary services and facilities.
- J. Provide each temporary service and facility ready for use at each location when service or facility is first needed to avoid delay in performance of Work. Maintain or expand as required and modify temporary services and facilities as needed throughout progress of Work. Do not remove until services or facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.
- K. Operate temporary services and facilities in safe and efficient manner. Do not overload temporary services or facilities, and do not permit them to interfere with progress of Work. Should services of independent engineer be required to survey existing or temporary utilities, it shall be at no cost to Owner. Do not allow unsanitary conditions, public nuisances or hazardous conditions to develop or persist at the Site.

- L. Do not permit disruption of existing services, freezing of pipes, flooding or contamination of water sources.
- M. Maintain temporary facilities in such manner as to prevent discomfort to users. Take necessary fire protection measures. Maintain temporary support facilities in sanitary manner so as to avoid health problems and other deleterious effects.
- N. Maintain Site security and protection measures in safe, lawful and publicly acceptable manner. Take necessary measures to prevent site erosion, as applicable. At no time is Site to be without protective fence enclosure(s), as required to protect general public.

#### 1.4 TEMPORARY UTILITIES

- A. Coordinate with the Owner's Authorized Representative and make connections to existing services to provide temporary services to the Project. Connections to the service shall be the responsibility of the Contractor.
- B. Coordinate with the Owner's Authorized Representative for acceptable time for service interruptions, where necessary to make connections for temporary services.
- C. Do not interrupt any utility service. Seventy-two (72) hours prior request and approval from the Owner's Authorized Representative is required to enable the Owner to shut down any utility required for the work. Contractor's employees shall **not** shut down utilities.

#### 1.5 TEMPORARY WATER SERVICE

- A. Provide temporary water service and distribution piping of sizes and pressures adequate for construction purposes throughout the construction period and until permanent service is in use, including but not limited to following uses:
  - 1. Construction processes.
  - 2. Fire protection, as appropriate.
  - 3. Drinking water.
  - 4. Cleaning.
- B. Where water use is authorized by Owner's Authorized Representative, connect to Owner's metered source, usage will be paid by Owner. Contractor shall exercise water conservation measures, provide hoses with threaded connection and provide temporary pipe insulation to prevent freezing. Owner's Authorized Representative reserves the right to require the Contract to furnish and install a temporary flow meter during construction and pay for water use, if contractor does not exercise satisfactory water conservation measures.

#### 1.6 TEMPORARY ELECTRICITY

- A. Provide weather proof, grounded temporary electric power service and distribution system of sufficient size, capacity and power characteristics to accommodate performance of Work during construction period.
- B. Install service and grounding in compliance with National Electric Code (NFPA 70). Include necessary meters, transformers, overload protected disconnect and main distribution switch gear.
- C. Provide metal conduit, tubing or armored cable for protection of temporary power wiring where exposed to possible damage during construction operations.
- D. Temporary service electrical wiring will be limited to 110-120 volt, 20-amp rating, and wiring of lighting circuits may be non-metallic sheathed cable in areas where located overhead and exposed

for surveillance, where permitted by code. Do not wire temporary lighting with plain, exposed (insulated) electrical conductors. Provide metal enclosures or boxes for wiring devices.

- E. For power hand tools and task lighting, provide temporary 4-gang outlets at each floor level, spaced so that 100-foot extension cord can reach each area of Work. Provide separate 110 120 volt, 20 amp circuit for each 4-gang outlet (4 outlets per circuit).

#### 1.7 TEMPORARY LIGHTING

- A. Wherever overhead floor or roof deck has been completed, install temporary lighting adequate to provide sufficient illumination for safe Work and traffic conditions in every area of Work. Take precautions to limit glare or direct illumination into areas occupied after dark.
- B. Provide and maintain lighting for construction operations to achieve minimum lighting level of 2 watt/sq. ft.
- C. Provide and maintain 1 watt/sq. ft. lighting to staging and storage areas during periods of non-construction after dark for security purposes.
- D. Provide and maintain 0.25 watt/sq. ft. lighting to interior work areas during periods of non-construction after dark for security purposes.
- E. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- F. Maintain lighting and provide routine repairs.

#### 1.8 TEMPORARY TELEPHONE, FAX AND E-MAIL

- A. The Owner will provide connection line(s) for temporary telephone, facsimile (FAX) machine and electronic mail service to the job site field office location. Telephone service will be local access limited. Coordinate location and setup with the Owner's Authorized Representative.
- B. The Contractor shall provide temporary on site telephone equipment, facsimile (Fax) machine and electronic mail access system on dedicated lines at field office. See Section 013100, Project Administration for off site emergency contact requirements.
- C. Maintain temporary telephone, facsimile and e-mail service from start of Work through Final Completion.

#### 1.9 TEMPORARY HEAT

- A. Provide and pay for heat devices as required to maintain specified conditions for construction operations.

#### 1.10 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases. See Section 017500, Indoor Air Quality for addition temporary ventilation requirements.

#### 1.11 TEMPORARY SANITARY FACILITIES

- A. The Contractor and subcontractors may use Owner designated restroom facilities located on the premises. The Contractor shall be responsible for maintaining the designated restroom facilities in a clean and sanitary condition or the privilege may be revoked. Coordinate restroom use with the Owner's Authorized Representative.

- B. Do not discharge liquid wastes into sewers or drainage facilities, containing excessive amounts of soil, construction debris, chemicals, oils and similar contaminants that might clog sewers or pollute waterways. The contractor shall bear the cost of any damages to the sewer system, caused directly or indirectly by his crews or subcontractors.

#### 1.12 WASTE DISPOSAL SERVICE

- A. If existing sewers or drainage facilities cannot be lawfully used for discharge of liquid waste, provide containers to remove and dispose of waste off Site in a lawful manner. See Section 017419, Waste Management
- B. Provide solid waste disposal and recycling facilities for the removal of construction related materials, trash and debris, in accordance with Section 017419. No on-site area is available for a `roll-off` dumpster location. Coordinate with the City of Portland and the Owner's Authorized Representative the `hooding` of parking meters and the use of public right-of-way for rubbish disposal as required.
- C. Do not dispose of hazardous materials in a manner that could allow the materials to enter landfills, waterways or other unapproved facilities. The Contractor shall comply with the hazardous material provisions of OUS General Conditions for Public Improvements Section F, and Division 1 Section 017419.

#### 1.13 CONSTRUCTION AIDS & GENERAL SERVICE FACILITIES

- A. Construction Aids:
  - 1. Design, construct and maintain construction aids and miscellaneous general services facilities as needed to accommodate performance of Work. Construction aids and miscellaneous general services and facilities include, but are not limited to the following:
    - a. Temporary stairs and ladders.
    - b. Guardrails and barriers.
    - c. Walkways.
  - 2. Provide temporary stairs where ladders are not adequate for proper, safe or efficient performance of Work.
  - 3. Install and maintain temporary walkways around work and to field offices, toilets and other similar areas. Construct walkways of gravel or duckboard units.
  - 4. Provide lifting devices necessary for the proper and efficient movement of materials; provide operating personnel for equipment as required. Provide for use of all hoisting equipment on the project during "off hours" as required to prevent impeding the project schedule.
- B. Pollution Control:
  - 1. Provide general protection facilities, operate temporary facilities, conduct construction activities, and enforce strict discipline for personnel on Site by methods which comply with environmental regulations, and that minimize possibility that air, water and subsoil may be contaminated or polluted, or that other undesirable effects may occur from performance of Work.
- C. Noise Control:
  - 1. Contractor shall provide and maintain adequate and effective mufflers, sound barriers and controls for all construction equipment so that noise from this equipment can be

controlled to satisfaction of Owner. Coordinate with Owner's Authorized Representative when construction work requires use of air hammers or other objectionable noisy equipment. Comply with all laws and regulations applicable the noise pollution abatement and workplace noise.

2. Rotohammering, grinding, drilling or other excessively noisy operations shall be coordinated with Owner's Authorized Representative and scheduled to avoid impacting building occupants. Jack hammering shall not be allowed at existing building interiors.

D. Dust Control:

1. All streets, roads or detours used for hauling materials shall be oil dust treated as required to prevent dust, or continually watered to prevent dust. Dust prevention measures, both indoors and outdoors shall be continuous until Final Acceptance by Owner.
2. Provide interior dust control measures, such as temporary partitions, taping of air spaces at doors, maintenance of filters and protection of ducts, etc., as required to control dust. Coordinate to prevent accidental activation of particulate-sensing fire detection system as described under requirements for Hot Work Permit.

E. Erosion and Sediment Control:

1. Follow city approved master erosion control plan, when applicable. Maintain copy on site.

1.14 TEMPORARY ENCLOSURES

A. Security:

1. The Contractor shall be responsible for any and all protections required during performance of the work, and shall be responsible for any and all damages as specified in OUS General Conditions for Public Improvement Contracts Section G1.1. 2. The Owner will not be responsible for protection of materials or equipment from vandalism or theft. Security is the responsibility of the Contractor.

B. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism or theft.

C. Maintain a security program continuously throughout Project, until Owner occupancy or Owner acceptance precludes, need for security program.

D. Barriers:

1. Comply with recognized standards and code requirements for erection of substantially adequate barriers where needed to prevent accidents and losses. Paint with appropriate colors, graphics and warning signs to inform construction personnel and public of hazard of concern. Provide lighting and flashing signals as required.
2. Provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
3. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
4. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

E. Fencing:

1. Where fencing is required, install general enclosure fence with suitable lock for gates. Locate where indicated on Drawings or as required to substantially complete enclosure around Site or staging/construction operations. Install in



manner that will prevent unauthorized persons from easily entering Site. Except when otherwise directed, provide open-mesh, chain-link fencing with posts substantially set in ground, or in moveable concrete blocks.

2. Within five days of Commencement of Work, Contractor shall provide fencing plan for approval by Owner. Plan shall indicate existing fencing to remain, new fencing required and type, location and sequencing of temporary barriers or fencing required for fencing outside primary Site.

F. Protection of Installed Work:

1. Protect installed Work and provide special protection where specified in individual j Specification Sections.
2. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
3. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
4. 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.

1.15 PROJECT IDENTIFICATION

A. Project Identification Signage:

1. Project Identification Signage will be furnished by Owner and installed by Contractor. Coordinate signage placement with the Owner's Authorized Representative.
2. Project Identification Signage shall be installed by the Contractor within five (5) days of delivery by the Owner and shall be removed by the Contractor following notice of Substantial Completion and prior to Final Completion. Upon removal Project Identification Signage shall become the property of the contractor.
3. Project Identification Sign will consist of two signs, 4'x8' =32 sq ft area, 3/4" marine plywood mounted. Contractor to provide 4"x4" post or other materials and means to mount sign with bottom of sign 4 feet above ground.

B. Project Informational Signs:

1. Contractor shall provide temporary directional signs to direct traffic into and within site. Relocate as Work progress requires.

1.16 FIELD OFFICE

- A. Provide field office area, and storage and staging locations within the defined scope of work area and in a location approved by the Owner's Authorized Representative. Provide temporary lighting, heated and ventilation as specified herein.
- B. Provide plan table, notice boards and other furnishings as require for Contractor's daily operations and as required by the Owner's Authorized Representative.
- C. Provide on-site office equipment as specified herein.
- D. Relocate field office area, and storage and staging location as required to not impede work. At completion of Work, remove buildings, utility service and debris. Restore area to prior condition.

1.17 TRAFFIC REGULATION AND PARKING

A. Traffic Control:

1. Comply with all rules and regulations of Owner, City, State and county authorities regarding closing of public streets to use by public traffic, including pedestrians. No road shall be closed to public except by expressed by permission by Owner and City. Control obstructions and hazards with approved signs, barricades and lights where necessary to protect safety of public. Convenience of general public adjacent to Project, protection of persons and property, and access of emergency vehicles are of prime importance and shall be provided for in satisfactory manner.
- B. Flagging Services:
1. Contractor shall provide trained flaggers and barricade hazardous operations during construction activities requiring the use of street areas, as directed by the Owner's Authorized representative. Equip flaggers and guards on duty with approved red work apparel and stop/slow paddle kept clean and in good condition.
  2. Utilize traffic control cones, drums, flares and lights which are approved by the city of Portland Bureau of Transportation. Use flares and lights during hours of low visibility to delineate traffic lanes and guide traffic.
- C. Temporary Use of Roads:
1. Provide detours necessary for unimpeded traffic flow.
  2. Provide and maintain unobstructed access to fire hydrants.
  3. Maintain emergency vehicle top access to the premises.
- D. Construction Related Parking Control:
1. Contractor, sub-contractor and employee parking will not be provided on the premises. The purchase of hoods for parking meters from the city of Portland is suggested.
  2. Coordinate all construction deliveries with the Owner's Authorized Representative. Purchase and obtain a temporary parking permit from the Portland State University office of Transportation and Parking twenty-four (24) hours prior to anticipated delivery parking need. Temporary construction related parking shall be limited to an assigned staging area as approved in writing by the Owner's Authorized Representative. designated for Contractor's use.
  3. The Contractor shall be responsible for all contractor and sub-contractor parking citations by the City of Portland and the Portland State University office of Transportation and Parking. All citations must be paid prior to submission of Notice of Final Completion and Request for Final Payment.

#### 1.18 TEMPORARY FIRE PROTECTION

- A. Until fire protection needs may be fulfilled by permanent facilities, install and maintain temporary fire protection facilities of types needed to adequately protect against reasonably predictable and controllable fire losses.
1. Provide equipment of adequate capacity to extinguish minor fires in combustible material on the Premises during the construction period.
  2. Comply with applicable recommendations of NFPA Standard 10 "Standard for Portable Fire Extinguishers".
  3. Maintain equipment in working condition with current inspection certificate attached to each.
  4. Locate fire extinguishers where they are most convenient, visible and effective for their intended purpose, but provide no less than one extinguisher on each floor or in each general Work area, at or near each usable stairwell.
  5. Store combustible materials in containers in recognized fire-safe areas.

- B. Develop and supervise overall fire prevention and first-aid fire protection program for personnel at Project Site.
  - 1. Review needs with local fire department officials and establish procedures to be followed.
  - 2. Smoking is prohibited on the premises. Contractor's personnel are to abide by all rules and regulations regarding smoking and all other fire prevention regulations in force where the Work is to be performed. Smoking is not permitted in structures on the PSU campus.
  - 3. Post warning and information and enforce strict discipline.
  - 4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires.
  - 5. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of Ignition for fire.
  - 6. Contractor shall ensure that contractor's employees are familiar with Owner's fire procedures and location of fire hydrants and extinguishers in adjacent parts of building adjacent to the construction area.

#### 1.19 PROGRESS CLEANING

- A. Dirt and debris of all nature caused by execution of Work shall be removed from the Site at end of each work day. Contractor shall be responsible for disposal of all scraps and materials that are relative to this Project.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing space.
- C. Hose all paved areas staged with construction material and generally prepare area of Work for occupancy with no further clean-up required by Owner.
- D. Clean all spilled dirt, gravel or other foreign material caused by construction operations from all streets and roads at conclusion of each day's operations. Cleaning of large areas shall be by grader and front-end loader supplemented by washing with water power brushing and hand labor.
- E. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- F. Remove waste materials, debris, and rubbish from Site daily and dispose off-site.

#### 1.20 REMOVAL OF UTILITIES, FACILITIES AND CONTROLS

- A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of two (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. Restore permanent facilities used during construction to specified condition.

END OF SECTION

## SECTION 015500 - CONTRACTOR PARKING

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. All parking costs and expenses incurred by any contractor in the course of doing business on Owner's property are the sole responsibility of such contractor. There is no free parking on the Owner's property. Parking rates for the City of Portland are posted at the parking entrances or on parking meters. Vehicles without permits may be towed away at the expense of the vehicle's owner. Parking is not allowed on any Owner's roadway unless so indicated. The Contractor's authorized representative can obtain parking permits for its employees from the Portland State University Transportation & Parking Services Office, Neuberger Hall (503.725.3442) at prevailing rates. All costs for parking permits, parking in University parking lots and ramps, and any fines incurred by any contractor shall be the responsibility of the contractor.
- B. Contractor shall not park in any area not designated for vehicle parking. It will be the responsibility of such contractor to repair and/or reimburse Owner for any damage to Owner's property caused by contractor's vehicle.
- C. Vehicles to be parked on the Owner's property shall be governed by Owner's Transportation & Parking Services Office.

## 1.2 RELATED SECTIONS

- A. Additional requirements related to Quality Requirements may be provided as follows:
  - 1. OUS General Conditions
  - 2. Other Sections of the specifications.

END OF SECTION

## SECTION 015600 - TREE AND PLANT PROTECTION

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Work of this section includes preservation and protection of existing trees, shrubs, and lawn to remain.

## 1.2 GENERAL WORK CONSTRAINTS

- A. Unless indicated otherwise on the documents all existing trees, shrubs, and lawn shall remain and be protected.
- B. No work shall occur within the area inside the protective fencing.

## 1.3 COMPENSATION FOR DAMAGE TO EXISTING TREES

- A. The Contractor is responsible for compensating the Owner for any and all damage to trees, shrubs, and lawn.
- B. Compensation action and amounts shall be as directed and calculated by a certified Arborist selected by the Owner.

## PART 2 - PRODUCTS

## 2.1 TREE PROTECTION AND WORK LIMIT FENCING

- A. Protective Fencing: 6 foot tall temporary chain link fencing with temporary concrete post bases.

## PART 3- EXECUTION

## 3.1 INSTALLATION

- A. Provide protective fencing at the limits for construction as indicated on the landscape drawings and as approved in the Field by the Owner.
- B. Prior to beginning construction, tour the site with the Owner and outline the location where protective fencing shall be installed.
- C. Fencing shall be installed plumb in locations identified in the field by the Owner.
- D. Fencing used to define the edge of construction, where it coincides with the location approved by the Owner for plant protection fence, is acceptable for protection fencing.

## 3.2 MAINTENANCE

- A. Maintain all protective fencing plumb, tight, at full height, and where located in the field by District. Replace damaged fencing with new materials as needed.

## 3.3 REMOVAL

- A. Remove protective fencing just prior to the site review for Substantial Completion.

END OF SECTION

## SECTION 015700 - CONTRACTOR STAGING

## PART 1 - GENERAL

## 1.1 BUILDING ENTRY/ROUTES

- A. Contractor shall schedule all necessary material stocking, demolition and trash removal through building corridors and elevators during non-peak hours or as approved by the PSU (or "Owner") Project Manager. All materials will be brought into the building through the loading dock or approved entry and transported using the Owner's assigned elevator.
- B. The loading dock or entry is only to be used for loading and unloading. The loading dock or entry will not be used for parking. Vehicles left unattended will be towed at the expense of the Contractor.

## 1.2 PARKING

- A. Unless stated in a Contract, all parking will be at the expense of the Contractor. All vehicles parked on Owner's property must have a parking permit. The Contractor must arrange and secure for all temporary parking permits. Due to limited space, only work vehicles will be allowed at the worksite, and these may be enclosed within the Contractor's assigned fenced work area. Contractor shall make every effort to carpool to the worksite when possible. It is the Contractor's responsibility to secure all parking permits or pay the appropriate meter.

## 1.3 STAGING/LAY DOWN AREA

- A. During each phase of Construction, areas required for staging must be submitted to the Owner at least three (3) weeks in advance of the requirement. The date when the area will be reusable by Owner must be included.
- B. During construction, the Contractor shall provide all security for its materials, offices, staging and construction parking areas, etc. Owner shall have no responsibility for any of these items. Contractor shall also be responsible for maintaining a safe construction area on Owner's property and offsite as well, including, without limitation, keeping all public and private roadways and parking areas clean, safe and functioning. The Contractor shall only be obligated clean up of those portions of public or private roadways and parking which have been affected by Contractor's activities.
  - 1. Use of lay down area is for the staging and storing of construction related equipment or material for Contractor construction activities only as related to PSU projects.
  - 2. Contractor is responsible for making sure the lay down area complies with all local building and fire codes and regulations and all Owner's safety codes and requirements.
  - 3. Contractor is responsible for keeping the grounds surrounding the lay down area safe and clean of construction materials, litter, trash, and scrap materials. Continuous housekeeping is required including daily removal of combustible waste and storage of combustible waste in approved metal containers and trash bins with metal lids. Outdoor tool and equipment power cords shall be removed

- nightly. Clean-up and sweeping to be done on a daily basis at the completion of a work shift.
4. Contractor is responsible for their own trash management, including removal of trash from campus. Contractor shall comply with recycling guidelines specified in the Contract Documents.
  5. Work & safety rules specified in the Contract Documents apply to lay down areas. Construction Personal Protective Equipment is required in the lay down area.
  6. Owner will not be held liable for any loss or damage to any contractor structures or equipment in the lay down area.
  7. There is NO SMOKING in the lay down area or inside structures or shipping containers in the lay down area. No smoking signs shall be posted at these locations.
  8. Contractor is responsible for keeping all fire and emergency access lanes surrounding the lay down area open at all times. Fire lane parking is subject to immediate tow at Contractor's expense. Fire hydrants must be accessible at all times.
  9. Contractor's portable toilets must be located inside the designated lay down area and maintained to PSU's satisfaction at all times.
  10. Contractors will not be permitted to store any type of construction material on top of their shipping containers or structures for safety reasons. No combustible materials will be permitted to be stored under a storage trailer.
  11. Contractor shall return the lay down area in the same or better condition than when initially used. Payment and/or fees may be withheld until repairs by the Contractor have been completed to PSU's satisfaction.
  12. If outside staging of material is required in unpaved areas, Owner is not responsible for mud, dirt, snow, rain, ice and/or rust on materials.
  13. Materials stored in staging area(s) must be protected from the elements and from damage or degradation as required in contract documents.
  14. Typical temporary construction fencing shall be covered with opaque material to prevent seeing inside the fencing. Construction fencing shall be placed on the interior side of the opaque material.
  15. The lay down area shall be made as small as possible and configured to minimize impact to the daily operations of the campus. Contractor to use lay down area for minimal amount of material inventory as required to provide an efficient construction process.

END OF SECTION

## SECTION 016000 - PRODUCT REQUIREMENTS

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. The requirements specified in this section relate to general product requirements substitutions by the Contractor, Sub-contractors and Suppliers performing Work under these Contract Documents and includes:
1. Contractor's Responsibilities
  2. Product Options
  3. Substitution Requests during the Bidding Process
  4. Substitution Requests after the Award of Contract
  5. Substitutions not permitted
  6. Product Delivery, Storage & Handling
  7. Product Installation

## 1.2 RELATED WORK IN OTHER SECTIONS

- A. Additional Product Option and Substitution Request Information may be provided as follows:
1. OUS General Conditions
  2. Other Sections of these specifications.

## 1.3 DEFINITIONS

- A. "Products" are materials, machinery, components, equipment, fixtures and other systems incorporated into the Project, regardless of whether they were purchased for the Project or taken from the Contractor's previously purchased inventory. It does not include machinery and equipment used in preparation, fabrication, conveying and erection of the Work.
- B. "Materials" are products that must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed or installed to form units of Work.
- C. "Substitutions" includes proposed changes in products, materials, equipment, and methods of construction required by the Contract Documents.

## 1.4 REQUESTS FOR SUBSTITUTIONS

- A. Requests for substitution of products in place of those specified shall be in accordance with the Public Improvement Agreement, OUS General Conditions, with Supplemental Conditions, and as specified herein. The Contractor assumes responsibility for the requirements as set forth herein. Any cost or time impact shall be at the Contractors expense.

## 1.5 CONTRACTOR'S RESPONSIBILITIES

- A. In requesting substitution, the Contractor shall be comply with OUS General Conditions for Public Improvement Contracts, This includes but is not limited to the following:
1. Investigate proposed products and determine that they are equal or superior in all respects to products specified.
  2. Provide same guarantee for accepted substitutions as for products specified.



3. Coordinate installation of accepted substitutions into the Work, making such changes as may be required for the Work to be complete in all respects and within original time constraints.
4. Waive all claims for additional costs related to substitutions, which consequently become apparent.

## PART 2 - PRODUCTS

### 2.1 PRODUCT OPTIONS

- A. Contractor's Options in selecting products is limited by the requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects. Where products or manufactures are specified by name or manufacturer, they shall be assumed accompanied by the term, "or approved equal". Comply with the Contract Document requirements for Substitutions and submittals to obtain review from Architect and Owner's Authorized Representative for use of substitute products.

## PART 3 - EXECUTION

### 3.1 SUBSTITUTION REQUESTS DURING THE BIDDING PROCESS

- A. Substitution requests shall meet the following criteria for review by the Architect and Owner's Authorized:
  1. Submit five (5) copies of each request for substitution using the submittal process specified in Division 1, Section 013300, Item 3.1.
  2. Substitutions shall be requested using the Substitution Request Form provided herein.
  3. Itemized comparison of proposed substitution with product or method specified.
  4. Complete data on each material and system for this project only, substantiating compliance of proposed substitution with the Contract Documents.
  5. Complete evidence including test numbers and supporting reports indicating compliance with referenced standards.
  6. A statement from the Manufacturer(s) of the proposed substitution materials stating that any and all warranties required by the contract documents for the originally specified materials can and will be provided for the substitution materials, and that required warranties shall be issued upon successful completion of the Work.
- B. Substitutions shall be requested prior to the Deadline for Request for Change and Protests, and accepted by Addendum prior to the date and time bid materials are due at the PSU Office of Facilities.

### 3.2 SUBSTITUTION REQUESTS AFTER AWARD OF CONTRACT

- A. Substitutions will normally not be considered after date of Contract, except when required due to unforeseen circumstances. Within a period of thirty (30) days after date of Contract, the Owner may, at its option, consider formal written requests for substitution of products in place of those specified, when submitted in accordance with the requirements stipulated herein. Substitution requests shall meet the following criteria for review by the Architect and Owner's Authorized:
  1. Submit five (5) copies of each request for substitution using the submittal process specified in Division 1, Section 013300, Item 3.1.
  2. Substitutions shall be requested using the Substitution Request Form provided herein.

- B. To receive consideration, one or more of the following conditions must be documented in any such request:
  - 1. The substitution is required for compliance with final interpretation of code requirements or insurance regulations.
  - 2. The substitution is required due to unavailability of a specified product, through no fault of the Contractor.
  - 3. The substitution is required because subsequent information disclosed the inability of the specified product to perform properly or to fit in the designated space.
  - 4. The substitution is required because it has become clearly evident, in the judgment of the Owner, that a substitute would be substantially in the best interest of the Owner in terms of cost, time, or other considerations.
- B. For products specified only by referenced standards, provide products by any Manufacturer meeting standards specified.
- C. For products specified by naming one or more products, provide any product named. If certain conditional requirements are stipulated, each product must comply with these requirements. Requests for approval of substitutions are subject to meeting requirements stipulated above.
- D. For products specified by naming a product to match existing products or systems, provide product of the same name. There is no option and no substitution is allowed.
- E. For each substitution that is accepted, the Contractor shall coordinate the work of all other trades and modify surrounding conditions as required to complete the work to the satisfaction of the Owners Authorized Representative at no additional cost to the Owner.

### 3.3 SUBSTITUTIONS NOT PERMITTED

- A. Submitted without first requesting approval thereof in accordance with requirements of this Section.
- B. Acceptance will require substantial revision of the Contract Documents, except as allowed by Paragraph 3.2 above.

### 3.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
  - 1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and- other losses.
  - 3. Deliver, handle and store products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss. Control delivery schedules to ensure timely delivery for incorporation into the Work, while minimizing long-term storage at the site and preventing overcrowding of the construction area.
  - 4. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

5. Promptly inspect shipments to assure that products comply with requirements, quantities are correct and products are undamaged.
6. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

3.5 PRODUCT INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.
- B. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION

## SECTION 017300 - CUTTING AND PATCHING

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. Work of this Section includes administrative and procedural requirements for cutting and patching.

## 1.2 RELATED WORK IN OTHER SECTIONS

- A. Additional information regarding cutting and patching requirements may be found in the follows:
  - 1. OUS General Conditions
  - 2. Other Sections of these specifications.
  - 3. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division I Specification Sections, apply to this Section.

## 1.3 QUALITY ASSURANCE

- A. The Contractor shall perform all cutting and patching in conformance with OUS General Conditions for Public Improvements Section F.3 and as specified herein.
- B. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio. The Owner's Authorized Representative shall pre-approve all field modifications.
- C. Operational Limitations: Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operation life or safety.
- D. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. The contractor shall remove and replace construction cut and patched in a visually unsatisfactory manner at no expense to the owner.

## PART 2 - PRODUCTS

## 2.1 GENERAL REQUIREMENTS:

- A. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.

## PART 3 - EXECUTION

## 3.1 INSPECTION:

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.

### 3.2 PREPARATION:

- A. Temporary Support: Provide temporary support of work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

### 3.3 PERFORMANCE

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
- B. Cutting:
  - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
  - 2. Cut existing construction using methods least likely to damage elements retained or adjoining construction.
  - 3. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 4. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
  - 5. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
  - 6. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter.
- C. Patching:
  - 1. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
  - 2. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
  - 3. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
  - 4. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance.
  - 5. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and second coat.
  - 6. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
  - 7. Repaint patched areas to match existing undistributed areas.

D. Cleaning:

1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION

## SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT

## PART 1 - GENERAL

## 1.1 PROJECT GOALS

- A. The Owner requires that this project generate the least amount of waste and trash possible.

## 1.2 RELATED WORK IN OTHER SECTIONS

- A. Additional waste management requirements may be found in the following:
  - 1. OUS General Conditions
  - 2. Other Sections of these specifications.

## 1.3 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. Non-hazardous: 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.

#### 1.4 WASTE MANAGEMENT REQUIREMENTS

- A. The contractor shall familiarize himself with the relevant requirements, provide the necessary documentation and instruct all sub-contractors and suppliers regarding energy efficiency, air quality, demolition, recycling, waste management and final cleaning.
- 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. 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.
- E. 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. The city of Portland requires all building projects with a permit value of \$50,000 or more to separate and recycle certain materials from the job site. The contractor shall be responsible for assuring recycling at the job site and for completing the pre-construction recycling plan form.

#### PART 2 - PRODUCTS

- 2.1 Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues. See Division 1 Section 013300 for submittal procedures.
- 2.2 Submit Waste Disposal Reports with each application for progress payment, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report. Failure to submit Report will delay payment. Prepare Waste Disposal Reports as follows:
  - A. Submit Report on a form acceptable to Owner.
  - B. Landfill Disposal: Include the following information:



1. Identification of material.
  2. Amount, in tons or cubic yards, or trash/waste material from the project disposed of in landfills.
  3. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
  4. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
- C. Incinerator Disposal: Include the following information:
1. Identification of material.
  2. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
  3. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
  4. Included manifest, weight tickets, receipts, and invoices as evidence of quantity and cost.
- D. Recycled and Salvaged Materials: Include the following information for each:
1. Identification of material, including those retrieved by installer for use on other projects.
  2. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
  3. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
  4. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
  5. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
- E. Material Reused on Project: Include the following information for each:
1. Identification of material and how it was used in the project.
  2. Amount, in tons or cubic yards.
  3. Include weight tickets as evidence of quantity.
- F. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

### PART 3 - EXECUTION

#### 3.1 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Designate an on-site person or persons responsible for instructing workers and overseeing documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Architect, and Owner's Authorized Representative.
- 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.

- 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. Provide containers as required.
  2. Provide adequate space for pick-up and delivery and convenience to contractors.
  3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Materials: If, during the course of the Work, the Contractor observes or suspects the existence of Hazardous Materials in the structure or components within the defined scope of work area, the Contractor shall immediately stop Work in the immediate area and notify the Owner's Authorized Representative, who will, under separate contract, facilitate the remove of the hazardous material. The Contractor will be required to schedule ten (10) days of slack or "down" time for the removal of potential unforeseen materials. Any delay caused by asbestos abatement that lasts less than ten (10) days shall not constitute a delay as defined in Section D.2 of the OUS General Conditions for Public Improvement Contracts and shall not result in any additional compensation to the contractor. If removal of the material takes more than ten (10) days, the Contractor shall be entitled to an extension of the completion date for the Work equal to the number of days required for removal, plus reimbursement for Contractor's cost of the Work for only those days in excess of ten (10).
1. Hazardous Material abatement in the vicinity of the defined scope of work area was performed in January 2003. A copy of the Asbestos Abatement Inspection Report shall be available to bidders and shall be maintained on the job site throughout the course of work.
  2. Roofing samples were taken in March of 2011. These samples were tested for the presence of asbestos with none being detected. A copy of the test results shall be available to bidders and shall be maintained on the job site throughout the course of work.
- 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 017500 - INDOOR AIR QUALITY

## PART 1 - GENERAL

## 1.1 PROJECT GOALS

- A. The owner and building tenants will occupy adjacent areas of the premises during the entire period of construction. The Contractor shall maintain indoor air quality of occupied spaces throughout the construction period to permit normal operations and upon substantial completion provide premises and building systems that meet minimal indoor air quality standards as described herein.
- B. Dust and Airborne Particulates: Prevent dust and other particulates from entering HVAC ducts and equipment, and from migrating into occupied spaces.
  - 1. Cleaning of existing ductwork to remain is not contemplated under this contract. Verify the condition of existing ducts and equipment prior to starting work.
  - 2. The Contractor shall bear the cost of duct and equipment cleaning required due to failure to protect ducts and equipment from construction dust.
  - 3. The Contractor shall coordinate with the Owner's Authorized Representative and provide adequate barriers, taping, ventilation and filters to prevent dust, fumes, odors, vapors or other agents from impacting normal operations in adjacent occupied spaces. Failure to do so may result in suspension of Work at the Contractor's expense.
  - 4. Procedures and products have been specified to minimize indoor air pollutants:
    - a. Furnish Products meeting or exceeding the specifications.
    - b. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

## 1.2 RELATED WORK IN OTHER SECTIONS

- A. Additional information related to Indoor Air Quality management requirements, temporary facilities required and Owner's remedies for non-compliance may be found in the following:
  - 1. OUS General Conditions
  - 2. Other Sections of these specifications.

## 1.3 REFERENCES

- A. ASHRE 62 – Ventilation For Acceptable Indoor Air Quality; 1999 and Addenda.
- B. ASHRAE Std. 129 – Measuring Air-Change Effectiveness; 1997.
- C. Oregon Administrative Rules Sections; 437-002—0081, 437-002-0107, 437-002-0382.
- D. Oregon Administrative Rules Section 437-003-0027.

## 1.4 DEFINITIONS

- A. Absorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.

- B. Contaminates: Gases, vapors, smoke, airborne mold and mildew, and other regulated pollutants including but not limited to construction related noise.
- C. Particulates: Dust, dirt and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, adhesives and other products that emit water vapor or volatile organic compounds during the installation, drying, or curing processes.

## PART 2 - PRODUCTS

NOT USED

## PART 3 - EXECUTION

### 3.1 CONSTRUCTION PROCEDURES

- A. Prevent the absorption of moisture and humidity by absorptive materials by:
  - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
  - 2. Delivering and storing such materials in fully sealed moisture-impermeable packaging.
  - 3. Provide sufficient ventilation for drying of wet work without impacting delivery schedules.
- B. Begin temporary construction heating and ventilation as soon as the work limits are substantially enclosed.
- C. If extremely dusty or dirty work or work that will create noxious odors must be performed, coordinate the temporary shut down of HVAC systems with the Owner's Authorized Representative. The Owner's Authorized Representative may require work by the Contractor outside of normal business hours (8:00 AM through 5:00 PM) if HVAC systems serving occupied areas are required to be shut down for extended periods.
- D. When working in a portion of an occupied building, provide barriers necessary to prevent movement of air from the construction area to occupied areas.
- E. HVAC equipment and ductwork SHALL NOT be used for ventilation during construction:
  - 1. Provide minimum temporary ventilation equivalent to 1.5 air changes per hour. Increase as required for wet work.
  - 2. Exhaust directly to outside. The Owner's Authorized Representative shall approve the Contractors exhaust venting plan including; equipment, routing and outlet prior to installation.
  - 3. Seal HVAC air inlets and outlets immediately after duct installations.
- F. Do not store construction materials or waste in mechanical rooms, electrical rooms or exit ways. Coordinate all materials storage with the Owner's Authorized Representative.
- G. Prior to use of return air ductworks without intake filters, remove dust and debris generated by construction activities.

1. Inspect duct intakes, return air grills, and terminal units for dust.
  2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduits.
  3. Clean tops of doors and frames.
  4. Clean mechanical and electrical rooms where work is performed, including the tops of pipes, ducts, conduits, equipment and supports.
  5. Clean return plenums of air handling units.
  6. Remove intake filters last, after all cleaning operations are complete.
- H. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.
- I. Use other relevant recommendations of SMACNA IAQ Guidelines for Occupied Buildings Under Construction to avoid unnecessary contaminants due to the construction process.
- J. Perform Air Contaminant Testing as specified herein.

### 3.2 AIR CONTAMINANT TESTING:

- A. Perform air contaminate testing before starting construction, as a baseline for evaluating post-occupancy test results, as specified herein.
- B. Perform air contaminate testing prior to submitting for substantial completion.
- C. Do not start air contaminant testing until:
1. All other construction operations are substantially complete.
  2. HVAC systems have been tested adjusted, and balanced for proper operation.
  3. New HVAC unit air filters have been installed.
- D. Collect the following indoor air samples from representative spaces of the work areas:
1. Collect samples while windows and exterior doors are closed, HVAC system is in normal operation and the building premises are unoccupied.
  2. Collect samples in each space served by the new air handling system.
  3. Collect air samples between a height of 48 inches and 72 inches above finished floor.
  4. Collect samples from same locations on three separate days and average the results of the three samples.
- E. Submit a report analyze the air samples and compare them against the pre-construction baseline (See Section 013300 for submittal procedure).
- F. Air Contamination Concentrations and Limits shall be as set forth in the Oregon Administrative Rules and as follows (the most restrictive shall apply):
1. Carbon Monoxide: Measure in ppm, in relation to outside air, at air intake; not more than outside air.
  2. Airborne Mold and Mildew: Measure in relation to outside air, at air intake, but in no case less than 48 inches above finish grade; not more than outside air.
  3. Formaldehyde: Measure in micrograms per cubic meter in relation to outside air, at air intake; Not more than 20 micrograms per cubic meter higher than outside air.
  4. Total Volatile Organic Compounds (TVOC): Measure in micrograms per cubic meter, in relation to outside air, at air intake; Not more than 200 micrograms per cubic meter higher than outside air.

5. Total Particulate Matter: Measure in micrograms per cubic meter, in relation to air, at air intake, not more than 20 micrograms per cubic meter higher than outside air.

3.3 VENTILATION EFFECTIVENESS TESTING:

- A. Perform ventilation effectiveness testing prior to substantial completion.
- B. Do not begin ventilation effectiveness testing until:
  1. HVAC systems have been tested adjusted, and balanced for proper operation.
  2. Air contamination testing has been completed satisfactorily.
  3. New HVAC unit air filter have been installed.
- C. Test each air handler zone in accordance with ASHRAE 129.
- D. If calculated air change effectiveness for a particular zone is less than 0.9 due to inadequate balancing of the system, adjust and retest at no additional cost to the Owner.

END OF SECTION

## SECTION 017700 - CLOSEOUT PROCEDURES

## PART 1 - GENERAL

## 1.1 DESCRIPTION:

- A. The requirements specified in this Section relate to all Contractors individually performing Work under these Contract Documents and include:
  - 1. Final Cleaning
  - 2. System Start-up, Testing & Adjusting
  - 3. Operations & Maintenance Manuals
  - 4. Warranties & Bonds
  - 5. Training
  - 6. Spare Parts & Extra Quantities
  - 7. Project Record Documents
  - 8. Final Review and Payment
- B. Project closeout is a term used to describe certain collective project requirements, indicating Work under this Contract that is fulfilled near the end of the Contract time in preparation for Final Completion, as well as Final Payment to the Contractor.
- C. Special requirements for individual units of work may be included in appropriate Specification Sections of this Project Manual.

## 1.2 RELATED WORK IN OTHER SECTIONS

- A. Additional Contract closeout requirements may be provided as follows:
  - 1. OUS General Conditions
  - 2. Supplementary General Conditions
  - 3. Section 013300, Submittals
  - 4. Other Sections of these Specifications

## PART 2 - PREREQUISITES TO SUBSTANTIAL COMPLETION

## 2.1 GENERAL DESCRIPTION:

- A. Substantial Completion shall be defined per OUS General Conditions for Public Improvement Contracts Section A.1, and Notification of Substantial Completion by the Contractor to the Owner shall be through the Architect as specified in Section K.4 of the same and as supplemented by OUS Supplemental General Condition SG-6. See Division 1, Section 013300 for general Submittal Review Procedure.
- B. Submit Certificate of Substantial Completion with accompanying `punchlist' and date for punchlist completion to the Architect once the Contract Documents have been reviewed, Work has been inspected and all prerequisites to substantial competition have been addressed.
- C. Prior to signing the Certificate of Substantial Completion, the Architect will perform one Substantial Completion review of the Work. The Contractor shall pay the cost of additional Substantial Completion reviews of the Work.

## 2.2 FINAL CLEANING

- A. Perform final cleaning of all items of Work prior to Substantial Completion review of the Work. Employ professional cleaners for final cleaning. Clean each surface or unit of work to condition expected from normal commercial building cleaning and maintenance program. Comply with all manufacturer's recommendations. Complete the following prior to requesting Architect's review of the Work for Substantial Completion certification:
1. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.
  2. Vacuum all carpeted, fabric and other soft surfaces.
  3. Clean all Contractor and Owner provided equipment and fixtures.
  4. Clean or replace all filters of operating equipment.
  5. Clean debris from roofs, gutters, downspouts and drainage systems impacted by the Work.
  6. Clean the Project Site and adjacent areas impacted by the Work, including landscaped and parking areas, or rubbish, litter and other foreign substances. Sweep paved areas to broom clean condition. Remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted to smooth, even-textured surface.
  7. Re-clean areas and equipment prior to inspection for Final Completion, if dirtied in completion of punchlist work.
- B. Unless otherwise directed by the Architect or Owner's Authorized Representative, remove temporary protective devices and facilities, which were installed during the course of the Work to protect previously completed work from the remainder of the construction to be completed, or to protect the public.
- C. Comply with all safety standards and governing regulations for cleaning and dispose of waste materials in accordance with Division 1, Section 017419 and the OUS General Conditions for Public Improvement Contracts.

### 2.3 SYSTEM START-UP, TESTING & ADJUSTING

- A. The Contractor shall coordinate the scheduling for the start-up and testing of various equipment and systems provided by the Contractor and Owner with the Owner's authorized representative.
- B. Notify the Owner's Authorized Representative and the Architect a minimum of fourteen (14) calendar days prior to the start-up or testing of each item.
- C. The Contractor shall submit to the Owner's Authorized Representative for review and approval, a minimum of fourteen (14) calendar days prior to the start-up or testing, five (5) copies of the following:
1. A paragraph-by-paragraph program of the Contractor's proposed testing procedure, developed to demonstrate compliance with the contract documents.
  2. Check off sheets for the review of each item of equipment and system.
  3. Each program and check off sheet shall provide the following information:
    - 1) Project information required by Division 1, Section 013300.
    - 2) Product information required by Division 1, Section 013300.
    - 3) Other information as required the fully describe the item.
    - 4) Provide spaces for testing "Review" sign off by Owner's Authorized Representatives and the Architect's Authorized Representative



- D. Verify that each piece of equipment or system has been checked for proper connection of services, lubrication, drive rotation, belt tension, control sequencing or other conditions that could cause damage.
- E. Verify that tests, meter readings and specified electrical characteristics agree with those required by equipment or system manufacturers.
- F. Verify that wiring, piping and support components for equipment are complete and tested.
- G. Execute start-up under the supervision of the Owner's Authorized Representative(s), the responsible manufacturer's representative, Contractor's personnel in accordance with the manufacturer's recommendations.
- H. Submit five (5) copies of all Installation, Adjustment and Balancing and Testing Reports for each piece of equipment and system in accordance with the Submittal Review Procedures, specified in Division 1, Section 013300, Item 3.1.
- I. Operating equipment and systems shall be tested in the presence of the Owner's Authorized Representatives and the Architect's Authorized Representative to demonstrate compliance with the Contract Documents and the manufacturer's recommendations:
  - 1. Testing shall be conducted under operating conditions as specified by the Owner's Authorized Representatives and the Architect's Authorized Representative.
  - 2. Copies of all test reports shall be included in the Project Record Documents.
- J. All elements of systems shall be tested to demonstrate that total systems satisfy all requirements of the Contract Documents. Test each piece of equipment for proper operation, followed by each subsystem, followed by entire system, followed by interfaces with other major systems.
- K. The Contractor shall provide all materials and equipment required for equipment and system testing.
- L. The Contractor shall perform the following minimal tests and additional tests as required by the Owner's Authorized Representative:
  - 1. System shall be checked for proper installation, and shall be adjusted and calibrated to verify that it is ready to function as specified.
  - 2. All system elements shall be checked to verify that they have been properly installed and that all connections have been made correctly.
  - 3. All discrete elements and sub-systems shall be adjusted and balanced and shall be checked for proper operation.

#### 2.4 OPERATIONS & MAINTENANCE MANUALS

- A. The Contractor shall Operations and Maintenance Manuals for review and project record documentation in accordance with OUS General Conditions for public Improvement Contract Section K.2, in accordance with the Submittal Review Procedures, specified in Division 1, Section 013300, Item 3.1.
- B. Include Operation and Maintenance instructions complete with technical information, required warranties & bonds and name, address and phone number of the Contractor(s) and Manufacturer(s) of each material and product. Bind in separate three-ring binders. Label similar to Project Documents binder with dividers by Specification section and supplier.

#### 2.5 WARRANTIES & BONDS

- A. Provide all warranties and bonds specified in other Sections of this project manual.
- B. Include all required warranties and bonds in the Operations and Maintenance Manuals in accordance with Item 2.04 herein.
- C. List Subcontractor, supplier and manufacturer, with address and telephone number of responsible principles.
- D. Verify that documents are in proper form, contain all information, and are notarized as applicable.
- E. Co-execute documents as required.

## 2.6 TRAINING

- A. The Contractor shall coordinate with the Owner's Authorized Representative training sessions for all equipment and systems in accordance with OUS General Conditions for public Improvement Contract Section K.5.

## 2.7 SPARE PARTS & EXTRA QUANTITIES

- A. The Contractor shall provide spare parts and extra quantities in accordance with OUS General Conditions for public Improvement Contract Section K.6.
- B. The Contractor shall submit in accordance with Division 1 Section 013300 Item 3.1, five (5) copies of the following:
  - 1. Check off sheets for the review of each item of material or product for which extra quantities are required.
  - 2. Each check off sheet shall provide the following information:
    - a. Project information required by Division 1, Section 013100, Item 1.5.
    - b. Product information required by Division 1, Section 013100, Item 3.6.
    - c. Amount of extra parts or quantity required.
    - d. Provide spaces for testing "Review" sign off by Owner's Authorized Representatives and the Architect's Authorized Representative.
- C. Coordinate delivery to the Owner with the Owner's Authorized Representative and submit receipts of delivery corresponding to spare parts and extra quantities check off sheet.

## 2.8 PROJECT RECORD DOCUMENTS

- A. Submit three (3) copies of the Project Record Documents for review in accordance with Division 1 Section 013300 Item 3.1. The Project Record Documents shall be organized to include the following information:
  - 1. Title and date of Project, Owner's Project Number
  - 2. Table of Contents
  - 3. Specifications
  - 4. As-Built Drawings (blueprints or photocopies)
  - 5. Inspection Reports, as applicable
  - 6. Warranty(ies), as applicable
  - 7. Operations and Maintenance Instructions

8. Approved and stamped Shop Drawings, Product Data and Samples (Provide 1 set of reproducible copies for Owner's file, in Microsoft Word or AutoCAD 2000 electronic formats, or on 3 MIL thick double sided and toothed Mylar.)
- B. Bind each copy of the Project Record Documents in a black, hard cover, three-ring binder with each Section clearly indexed with tabbed divider pages.
- C. The project team list shall include the address and phone number of the Owner, Architect, Contractor, inspectors, subcontractors, and the materials manufacturers.
- D. Legibly mark each Specification Section to indicate actual as-built conditions. The as-built Specifications shall clearly indicate changes in the Work made by Addendum(a) and/or Change Order(s), actual materials used, and actual Manufacturer(s) used.
- E. Legibly mark the drawings to indicate actual "as-built conditions." The drawings shall clearly indicate changes in the Work made by Addendum(a) and/or Change Order(s). The Owner shall employ the Architect to modify CAD documents into a "recorded as-built" base for Owner's usage, based on information provided by Contractor.
- F. Include inspection reports and Architect's field reports, if applicable.
- G. Include a copy of required Warranty(ies) clearly marked to identify the Owner's responsibilities under the terms of the Warranty(ies).
- H. Make corrections to all Project Record Documents and resubmit as part of Final Completion Review.
- I. Contact the Owner's Authorized Representative for a sample of acceptable Record Documents if needed.

### PART 3 - PREREQUISITES TO FINAL COMPLETION AND PAYMENT

- 3.1 The Contractor shall comply with all terms of OUS General Conditions for Public Improvement Contract Sections E.6 and I.1, unless otherwise amended herein, prior to filing Notice of Final Completion or requesting Final Payment.
- 3.2 The Contractor shall return all keys requested for access to buildings and work areas and obtain a deposit refund, as specified in Division 1, Section 01040, Item 1.09.
- 3.3 The Contractor shall notify all Subcontractors in writing of incomplete and/or incorrect items and the anticipated filing of Final Completion. Notify far enough in advance of the completion date that the Work can be completed on schedule. Said Work shall be immediately corrected.
- 3.4 Submit to the Owner's Authorized Representative Lien Releases in accordance with OUS General Conditions for Public Improvement Contract Section K.8.
- 3.5 The Contractor shall provide the Owner with an unconditional Certificate of Occupancy from the local building officials, in accordance with OUS General Conditions for Public Improvement Contract Section K.8.
- 3.6 Notify the Architect in writing that all items are complete and ready for Final Completion review and that the Work product is fully usable.
- 3.7 Submit three (3) copies of all record documents for Final Completion review at this time.

- 3.8 The Architect will review all documents. The Architect will review all Work that has been certified as complete to the best knowledge of the Contractor. The Architect will also list all remaining incomplete punchlist Work and assign a probable value and time to complete such uncompleted Work.
- 3.9 The Architect will review the Work for conformance. Time is of an essence on this project. If the Work is found to be in nonconformance, the Architect will notify the Owner of the nonconforming items and probable value and time for completion. Nonconforming items will require retainage of monies to ensure that the Contractor will complete all Work within the time established by the Public Improvement Agreement and as amended by executed Change Orders.
- 3.10 The Contractor shall make the required corrections to the Work expeditiously. Sufficient retainage monies will be held to pay for uncompleted Work, should the Contractor fail to perform. A letter will be addressed to the Contractor noting the project status and the monies available for a partial-final payment upon receipt of billing.
- 3.11 When Contract closeout procedures are completed and all Punchlist deficiencies have been corrected, final acceptance by the Owner will be documented. The Contractor will receive written notice of acceptance of the Work and notification that final payment may be billed and released. Note that final wage rate submittal and documentation of all BOLI fees are required prior to final payment.
- 3.12 The Contractor shall be responsible for all parking citations received in relation with the project from the City of Portland and the Portland State University office of Transportation and Parking. All citations must be paid prior to submission of notice of Final Completion and Request for final Payment.
- 3.13 All warranties shall commence and become effective in accordance with Section I of the OUS General Conditions for Public Improvement Contracts and as modified by OUS Supplemental General Condition SG-6.

#### PART 4 - PRODUCTS

NOT USED

#### PART 5 - EXECUTION

NOT USED

END OF SECTION

## SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

## 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. Demolition and removal of selected portions of building or structure.
  - 2. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
  - 1. Section 017300 "Execution" for cutting and patching procedures.
  - 2. Section 070150 "Preparation for Re-Roofing" for roof tear-off and preparation.

## 1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, store and clean for reinstallation.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. 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.

## 1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

## 1.5 SUBMITTALS

- A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property , for dust control and , for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.

2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

#### 1.6 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  1. Maintain fire-protection facilities in service during selective demolition operations.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

- D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
  - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
  - 1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
3. Cover and protect furniture, furnishings, and equipment that have not been removed.
4. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

### 3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."



- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

## SECTION 030130 - MAINTENANCE OF CAST-IN-PLACE CONCRETE

## 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. Removal of deteriorated concrete and reinforcement and subsequent replacement and patching.
  - 2. Steel structural reinforcement.
- B. Related Sections include the following:
  - 1. Division 02 Section "Selective Demolition".
  - 2. Division 05 Section "Structural Steel Framing" for concrete repair with structural steel framing.

## 1.3 UNIT PRICES

- A. General: Unit prices include the cost of preparing existing construction to receive the work indicated and costs of field quality control required for units of work completed.
- B. Concrete Removal and Replacement or Patching: Work will be paid for by the cubic foot (cubic meter) computed on the basis of rectangular solid shapes approximating the actual shape of concrete removed and replaced with average depths, widths, and lengths, measured to the nearest inch (centimeter).

## 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.
- B. Samples: Cured samples for each exposed product and for each color and texture specified, in manufacturer's standard size appropriate for each type of work.
- C. Samples for Initial Selection: Cured samples for each exposed product and for each color and texture specified.
  - 1. Include sets of patching-material Samples in the form of briquettes, at least 3 inches (75 mm) long by 1-1/2 inches (38 mm) wide representative of the range of concrete colors on the building. Document each Sample with product, mix, and or other information necessary to replicate it.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installers and manufacturers.
  - 1. For products required to be installed by workers approved by product manufacturers, include letters of acceptance by product manufacturers certifying that installers are approved to apply their products.
- B. Material Certificates: For each type of portland cement aggregate supplied for mixing or adding to products at Project site.
- C. Product Test Reports: For each manufactured bonding agent and cementitious patching mortar, for tests performed by manufacturer and witnessed by a qualified testing agency.

## 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Each manufactured bonding-agent and cementitious patching-mortar manufacturer shall employ factory-trained technical representatives who are available for consultation and Project-site inspection and assistance at no additional cost.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer to apply packaged patching-mortar materials.
- C. Maintenance Program: Prepare a written plan for maintenance of cast-in-place concrete, including each phase or process, protection of surrounding materials during operations, and control of debris and runoff during the Work. Describe in detail materials, methods, equipment, and sequence of operations to be used for each phase of the Work.
- D. Source Limitations: Obtain concrete patching and rebuilding materials through one source from a single manufacturer.
- E. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original and unopened containers, labeled with type and name of products and manufacturers.
- B. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.
- C. Store cementitious materials off the ground, under cover, and in a dry location.

- D. Store aggregates, covered and in a dry location, where grading and other required characteristics can be maintained and contamination avoided.

#### 1.9 FIELD CONDITIONS

- A. Cold-Weather Requirements for Cementitious Materials: Do not apply unless air temperature is above 40 deg F (5 deg C) and will remain so for at least 48 hours after completion of Work.
- B. Cold-Weather Requirements for Cementitious Materials: Comply with the following procedures:
  - 1. When air temperature is below 40 deg F (5 deg C), heat patching material ingredients and existing concrete to produce temperatures between 40 and 90 deg F (5 and 32 deg C).
  - 2. When mean daily air temperature is between 25 and 40 deg F (minus 4 and plus 5 deg C), cover completed Work with weather-resistant insulating blankets for 48 hours after repair or provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after repair.
  - 3. When mean daily air temperature is below 25 deg F (minus 4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after repair.
- C. Hot-Weather Requirements for Cementitious Materials: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Provide artificial shade and wind breaks, and use cooled materials as required. Do not apply to substrates with temperatures of 90 deg F (32 deg C) and above.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain each color, grade, finish, type, and variety of product from single source with resources to provide products of consistent quality in appearance and physical properties.
- B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

#### 2.2 BONDING AGENTS

- A. Epoxy Bonding Agent: ASTM C 881/C 881M, Type V and free of VOCs.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Construction Chemicals - Building Systems.
    - b. ChemCo Systems.
    - c. Dayton Superior Corporation.
    - d. Euclid Chemical Company (The); an RPM company.
    - e. Kaufman Products, Inc.
    - f. Sika Corporation; Construction Product Division.
    - g. Sto Corp., Concrete Restoration Division.
    - h. Unitex.
    - i. US SPEC; Division of US MIX Products Company.
    - j. W. R. Meadows, Inc.

### 2.3 PATCHING MORTAR

#### A. Patching Mortar, General:

1. Only use patching mortars that are recommended by manufacturer for each applicable horizontal, vertical, or overhead use orientation.
2. Color and Aggregate Texture: Provide patching mortar and aggregates of colors and sizes necessary to produce patching mortar that matches existing, adjacent, exposed concrete. Blend several aggregates if necessary to achieve suitable matches.
3. Coarse Aggregate for Patching Mortar: ASTM C 33, washed aggregate, Size No. 8, Class 5S. Add to patching-mortar mix only as permitted by patching-mortar manufacturer.

#### B. Job-Mixed Patching Mortar: 1 part portland cement and 2-1/2 parts fine aggregate complying with ASTM C 144, except 100 percent passing a No. 16 (1.18-mm) sieve.

#### C. Cementitious Patching Mortar: Packaged, dry mix for repair of concrete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. BASF Construction Chemicals - Building Systems.
  - b. CGM, Incorporated.
  - c. Dayton Superior Corporation.
  - d. Euclid Chemical Company (The); an RPM company.
  - e. Fox Industries, Inc.
  - f. Kaufman Products, Inc.
  - g. Sika Corporation; Construction Product Division.
  - h. Sto Corp.; Concrete Restoration Division.
  - i. Unitex.
  - j. US SPEC; Division of US MIX Products Company.
  - k. W. R. Meadows, Inc.
2. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C 109/C 109M.

### 2.4 OTHER MATERIALS

#### A. Portland Cement: ASTM C 150, Type I, II, or III unless otherwise indicated.

### 2.5 MIXES

#### A. General: Mix products, in clean containers, according to manufacturer's written instructions.

1. Do not add water, thinners, or additives unless recommended by manufacturer.
2. When practical, use manufacturer's premeasured packages to ensure that materials are mixed in proper proportions. When premeasured packages are not used, measure ingredients using graduated measuring containers; do not estimate quantities or use shovel or trowel as unit of measure.
3. Do not mix more materials than can be used within time limits recommended by manufacturer. Discard materials that have begun to set.

#### B. Dry-Pack Mortar: Mix patching-mortar dry ingredients with just enough liquid to form damp cohesive mixture that can be squeezed by hand into a ball but is not plastic.

- C. Concrete: Comply with Division 03 Section "Cast-in-Place Concrete."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Notify Architect seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.
- B. Locate areas of deteriorated or delaminated concrete using hammer or chain drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls make boundaries level and plumb, unless otherwise indicated.
- C. Pachometer Testing: Locate at least three reinforcing bars using a pachometer, and drill test holes to determine depth of cover. Calibrate pachometer using depth of cover measurements, and verify depth of cover in removal areas using pachometer.
- D. Perform surveys as the Work progresses to detect hazards resulting from concrete-maintenance work.

#### 3.2 PREPARATION

- A. Ensure that supervisory personnel are on-site and on duty when concrete maintenance work begins and during its progress.
- B. Preparation for Removal of Deteriorated Concrete: Examine construction to be repaired to determine best methods to safely and effectively perform concrete maintenance work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.
  - 1. Verify that affected utilities have been disconnected and capped.
  - 2. Inventory and record the condition of items to be removed for reinstallation or salvage.
  - 3. Provide and maintain shoring, bracing, and temporary structural supports as required to preserve stability and prevent unexpected or uncontrolled movement, settlement, or collapse of construction being demolished and construction and finishes to remain.
- C. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.
  - 1. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
  - 2. Use only proven protection methods appropriate to each area and surface being protected.
  - 3. Provide barricades, barriers, and temporary directional signage to exclude public from areas where concrete maintenance work is being performed.
  - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of concrete maintenance work.
  - 5. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.
  - 6. Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment that ensure that such water will not create a hazard or adversely affect other building areas or materials.
  - 7. Protect floors and other surfaces along haul routes from damage, wear, and staining.

8. Provide supplemental sound-control treatment to isolate removal and dismantling work from other areas of the building.
  9. Dispose of debris and runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
  10. Collect runoff from wet operations and dispose of by legal means off Owner's property.
- D. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.
1. Prevent solids such as aggregate or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from concrete maintenance work.
  2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- E. Concrete Removal:
1. Provide shoring, bracing, and supports as necessary. Strengthen or add new supports when required during progress of removal work. Do not overload structural elements with debris.
  2. Saw-cut perimeter of areas indicated for removal to a depth of at least 1/2 inch (13 mm). Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcement.
  3. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.
  4. Remove additional concrete if necessary to provide a depth of removal of at least 1/2 inch (13 mm) over entire removal area.
  5. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least a 3/4-inch (19-mm) clearance around bar.
  6. Test areas where concrete has been removed by tapping with hammer, and remove additional concrete until unsound and disbonded concrete is completely removed.
  7. Provide surfaces with a fractured profile of at least 1/8 inch (3 mm) that are approximately perpendicular or parallel to original concrete surfaces. At columns and walls, make top and bottom surfaces level unless otherwise directed.
  8. Thoroughly clean removal areas of loose concrete, dust, and debris.
- F. Reinforcing-Bar Preparation: Remove loose and flaking rust from reinforcing bars by high-pressure water cleaning, abrasive blast cleaning, needle scaling or wire brushing until only tightly adhered light rust remains.
1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, cut bars and remove and replace as directed by Architect. Remove additional concrete as necessary to provide at least 3/4-inch (19-mm) clearance at existing and replacement bars. Splice replacement bars to existing bars according to ACI 318 (ACI 318M) by lapping, welding, or using mechanical couplings.
- G. Surface Preparation for Sealers: Acid etch surface of concrete to produce a surface profile matching CSP 1 according to ICRI 03732. Prepare surface for acid etching by detergent scrubbing to remove oils and films that may prevent acid penetration.
1. Remove excess acid solution, reaction products, and debris by squeegeeing or vacuuming.
  2. Scrub surface with an alkaline detergent, rinse, and squeegee or vacuum.
  3. Check acidity of surface with pH test paper and continue rinsing until pH is acceptable to written requirements of sealer manufacturer.
  4. When pH is acceptable to written requirements of sealer manufacturer and surface is clean, vacuum dry.

## 3.3 APPLICATION

- A. General: Comply with manufacturer's written instructions and recommendations for application of products, including surface preparation.
- B. Epoxy Bonding Agent: Apply to reinforcing bars and concrete by brush, roller, or spray according to manufacturer's written instructions, leaving no pinholes or other uncoated areas. Place mortar or concrete while epoxy is still tacky. If epoxy dries, recoat before placing patching mortar or concrete.
- C. Placing Patching Mortar: Place as follows unless otherwise recommended in writing by manufacturer:
1. Provide forms where necessary to confine patch to required shape.
  2. Wet substrate and forms thoroughly and then remove standing water.
  3. Pretreatment: Apply specified bonding agent.
  4. General Placement: Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.
  5. Vertical Patching: Place material in lifts of not more than 2 inches (50 mm). Do not feather edge.
  6. Overhead Patching: Place material in lifts of not more than 2 inches (50 mm). Do not feather edge.
  7. Consolidation: After each lift is placed, consolidate material and screed surface.
  8. Multiple Lifts: Where multiple lifts are used, score surface of lifts to provide a rough surface for placing subsequent lifts. Allow each lift to reach final set before placing subsequent lifts.
  9. Finishing: Allow surfaces of lifts that are to remain exposed to become firm and then finish to a surface matching adjacent concrete.
  10. Curing: Wet-cure cementitious patching materials, including polymer-modified cementitious patching materials, for not less than seven days by water-fog spray or water-saturated absorptive cover.
- D. Dry-Pack Mortar: Use for deep cavities and where indicated. Place as follows unless otherwise recommended in writing by manufacturer:
1. Provide forms where necessary to confine patch to required shape.
  2. Wet substrate and forms thoroughly and then remove standing water.
  3. Pretreatment: Apply specified bonding agent.
  4. Place dry-pack mortar into cavity by hand, and compact tightly into place. Do not place more material at a time than can be properly compacted. Continue placing and compacting until patch is approximately level with surrounding surface.
  5. After cavity is filled and patch is compacted, trowel surface to match profile and finish of surrounding concrete. A thin coat of patching mortar may be troweled into the surface of patch to help obtain required finish.
  6. Wet-cure patch for not less than seven days by water-fog spray or water-saturated absorptive cover.
- E. Concrete: Place according to Division 03 Section "Cast-in-Place Concrete" and as follows:
1. Pretreatment: Apply epoxy bonding agent to reinforcement and concrete substrate.
  2. Standard Placement:
    - a. Use vibrators to consolidate concrete as it is placed.
    - b. At unformed surfaces, screed concrete to produce a surface that when finished with patching mortar will match required profile and surrounding concrete.
  3. Form-and-Pump Placement: Place concrete where indicated by form and pump method.



- a. Design and construct forms to resist pumping pressure in addition to weight of wet concrete. Seal joints and seams in forms and where forms abut existing concrete.
  - b. Pump concrete into place from bottom to top, releasing air from forms as concrete is introduced. When formed space is full, close air vents and pressurize to 14 psi (96 kPa).
4. Wet-cure concrete for not less than seven days by leaving forms in place or keeping surfaces continuously wet by water-fog spray or water-saturated absorptive cover.
  5. Fill placement cavities with dry-pack mortar and repair voids with patching mortar. Finish to match surrounding concrete.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
  1. Packaged, Cementitious Patching Mortar: Three randomly selected sets of samples for each type of mortar required, tested according to ASTM C 928.
  2. Job-Mixed Patching Mortar: Three randomly selected sets of samples for each type of mortar required, tested for compressive strength according to ASTM C 109/C 109M.
  3. Concrete: As specified in Division 03 Section "Cast-in-Place Concrete."
  4. Grouted Preplaced Aggregate: Tested for compressive strength of grout according to ASTM C 942.
    - a. Testing Frequency: One sample for each 25 cu. yd. (19 cu. m) of grout or fraction thereof, but not less than one sample for each day's work.
- C. Product will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 030130

## SECTION 033000 - CAST-IN-PLACE CONCRETE

## 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 specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes for the following:
  - 1. Building walls.
- B. Related Sections include the following:
  - 1. Section 03 01 30 "Maintenance of Cast-In-Place Concrete."

## 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
  - 2. Include substantiating substantial test data to show compliance with ACI 318 Chapter 5.
- C. Welding certificates.
- D. Qualification Data: For Installer.
  - 1. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
- E. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials
  - 2. Admixtures.
  - 3. Form materials and form-release agents.

4. Steel reinforcement and accessories.
5. Curing compounds.

#### 1.5 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM 94/C94M requirements for production facilities and equipment.
  1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities.
- B. **Testing Agency Qualifications:** An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
  1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
  2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician – Grade 1. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician – Grade II.
- C. **Source Limitations:** Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- D. **Welding:** Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- E. **ACI Publications:** Comply with the following unless modified by requirements in the Contract Documents:
  1. ACI 301, "Specification for Structural "Concrete", Sections 1 through 5.
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. **Concrete Testing Service:** Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- G. **Mockups:** Cast concrete formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.
  1. Build panel approximately 200 sq. ft. (18.6 sq. m) for slab-on-grade and 20 sq. ft. (9.3 sq. m) for formed surface in the location indicated or, if not indicated, as directed by Architect.
  2. Approved panels may become part of the completed Work if undisturbed at time of Substantial Completion.
- H. **Preinstallation Conference:** Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
  1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixes.

- c. Ready mix concrete manufacturer.
- d. Concrete subcontractor.
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, forms and form removal limitations, steel reinforcement installation, concrete repair procedures, and concrete protection.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

#### 1.7 SYSTEM DESCRIPTION

- A. Redesign or Departures from Requirements of the Contract Documents Initiated by Contractor:
  1. Obtain written acceptance from the Architect and Architect's consultants.
  2. Bear costs for Contractor-initiated or construction error due to changes in type, form, system, or details of construction from those indicated by the contract documents.
  3. Costs of review of such changes by Architect and Architect's consultants will be deducted from the Contract Sum by Change Order.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection.
  1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  2. Products: Subject to compliance with requirements, provide one of the products specified.
  3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to manufacturers specified.
  4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

#### 2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  1. Plywood, metal, or other approved panel materials as required to match existing concrete finishes.
    - a. High-density overlay, Class 1, or better.
    - b. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.
    - c. Structural 1, B-B, or better, mill oiled and edge sealed.
    - d. B-B (Concrete Form), Class 1 or better, mill oiled and edge sealed.

- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- C. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, will leave holes not larger than 1 inch (25 mm) in diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

### 2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed. Refer to General Structural Notes.
- B. Low-Alloy-Steel Reinforcing Bars: All reinforcing steel to be welded or bent in field: ASTM A 706/A 706M, deformed.

### 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type I/II.
    - a. Fly Ash: ASTM C 618, Class C or F. Refer to General Structural Notes.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregate: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.
  - 1. Maximum Coarse-Aggregate Size: 3/8 inch (19 mm), 1 inch (25 mm), 1-1/2 inches (38 mm).
  - 2. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3-mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3 mm).
- D. Water: ASTM C 94/C94-M and potable.

### 2.5 ADMIXTURES

- A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/ C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
  1. Products:
    - a. Axim Concrete Technologies; Cimfilm.
    - b. BASF Construction Chemicals - Building Systems; Confilm.
    - c. Burke by Edoco; BurkeFilm
    - d. ChemMasters; Spray-Film
    - e. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
    - f. Dayton Superior Corporation; Sure Film.
    - g. Euclid Chemical Company (the); Eucobar.
    - h. Kaufman Products, Inc.; Vapor Aid.
    - i. Lambert Corporation; Lambco Skin.
    - j. L&M Construction Chemicals, Inc.; E-Con.
    - k. MBT Protection and Repair, Div. of ChemRex; Confilm.
    - l. Meadows, W.R., Inc.; Sealtight Evapre.
    - m. Metalcrete Industries; Waterhold.
    - n. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
    - o. Sika Corporation, Inc.; SikaFilm.
    - p. Symons Corporation, a Dayton Superior Company; Finishing Aid.
    - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
    - r. Unitex; Pro-Film.
    - s. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 309, Type 1, Class B, dissipating.
  1. Products:
    - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
    - b. BASF Construction Chemicals - Building Systems; Kure 200.
    - c. ChemMasters; Safe-Cure Clear.
    - d. Conspec by Dayton Superior; W.B. Resin Cure.
    - e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
    - f. Edoco by Dayton Superior; Res X Cure WB.
    - g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
    - h. Kaufman Products, Inc.; Thinfilm 420.
    - i. Lambert Corporation; AQUA KURE - CLEAR.
    - j. L&M Construction Chemicals, Inc.; L&M Cure R.

- k. Meadows, W. R., Inc.; 1100-CLEAR.
- l. Nox-Crete Products Group; Resin Cure E.
- m. Right Pointe; Clear Water Resin.
- n. SpecChem, LLC; Spec Rez Clear.
- o. Symons by Dayton Superior; Resi-Chem Clear.
- p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
- q. Vexcon Chemicals, Inc.; Certi-Vex EnvIOCure 100.
- r. <Insert manufacturer's name; product name or designation>.

## 2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 and in accordance with the following:
  - 1. Compressive Strength: Refer to General Structural Notes.
  - 2. Maximum Water-Cementitious Materials Ratio: Refer to General Structural Notes.
  - 3. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having the air content specified in the General Structural Notes.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash: 20 percent.
  - 2. Combined Fly Ash and Pozzolan: 20 percent.
  - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
  - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 20 percent.
  - 5. Silica Fume: 10 percent.
  - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 30 percent with fly ash or pozzolans not exceeding 20 percent and silica fume not exceeding 10 percent.
  - 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent portland cement minimum, with fly ash or pozzolans not exceeding 20 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing or plasticizing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

## 2.8 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information
  - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

## 3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install keyways, reglets, recesses, and the like, for easy removal.
  - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete as required to match existing finishes.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.



- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete if concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

### 3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Architect.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.
- C. Adjust mix as required to maintain specified air content at the point of discharge.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301 and as follows:
  - 1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### 3.7 FINISHING FORMED SURFACES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- B. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where

### 3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1 by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of a floor covering used on Project.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.9 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

- B. Testing Agency: Engage a qualified independent testing and inspecting agency to perform tests, and inspections and to submit test reports
- C. Inspections: As indicated in the General Structural Notes.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
  - 2. Testing Frequency: Obtain at least one composite sample for each 150 cu. yd. (114 cu. m) or fraction thereof of each concrete mix placed each day and at least one composite sample for each 5000 square feet of surface area of slabs or walls.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  - 3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  - 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - 5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
  - 6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - 7. Compression Test Specimens: ASTM C 31/C 31M.
    - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
  - 8. Compressive-Strength Tests: ASTM C 39/C 39M; test one laboratory-cured specimen at 7 days, two at 28 days, and hold one for later testing.
    - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
  - 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
  - 10. Test results shall be reported in writing to Architect, Structural Engineer, concrete manufacturer, Building Official, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, type of break for both 7- and 28-day tests, and air content.
  - 11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  - 12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

## SECTION 051200 - STRUCTURAL STEEL

## 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. Structural steel.
- B. Related Sections include the following:
  - 1. Section 014000 "Quality Requirements" for independent testing agency procedures and administrative requirements.

## 1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

## 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD (standard for building structures).
  - 1. Fabricator shall be registered with and approved by authorities having jurisdiction/the City of Portland.
- B. Welding Standards: Comply with applicable provisions and qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel".
  - 1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
  - 2. Qualifications for Welding Work: Qualify welding personnel in accordance with AWS D1.1, "Qualification," (or approved equal).
    - a. Qualify welders in accordance with AWS D1.1 for each process, position, and joint configuration.
    - b. Welders who have not used the welding process for a period of 6 or more months shall be recertified.
    - c. If recertification of welders is required, retesting will be the Contractor's responsibility.
    - d. WPSs for each joint type shall indicate proper AWS qualification and be available where welding is performed.

- e. Each welder performing demand critical welds shall be qualified by testing in accordance with AWS D1.8 Part 5.
  - f. Welders whose work fails to pass inspection shall be requalified before performing further welding.
3. Welders shall meet City of Portland standards as certified by an approved testing laboratory.
- C. Comply with applicable provisions of the following specifications and documents:
1. AISC 303 "Code of Standard Practice for Steel Buildings and Bridges" (with exceptions noted in Part 1 of this Section).
  2. AISC 360 "Specification for Structural Steel Buildings, 13<sup>th</sup> edition.
  3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
  4. ASTM A 6 (ASTM A 6M) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

#### 1.6 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

#### 1.7 EXCEPTIONS TO AISC CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES

- A. Add the following paragraph to Section 1.8.1 of the AISC Code of Standard Practice for Steel Buildings and Bridges:
- “The Contractor shall have sole responsibility for site safety. The Fabricator and Erector shall review the Contract Documents and if the structure, as shown on those documents, is in conflict with the requirements of any safety regulations, the Fabricator shall notify the Structural Engineer of Record prior to

commencing shop drawing production. If the Fabricator and/or Erector fail to notify the Structural Engineer of Record, as stated above, they shall become responsible for all costs for correcting such conflicts with the requirements of any and all safety regulations.”

- B. Add the following paragraph to Sections 7.5.1 **AND** Section 7.5.3 of the AISC Code of Standard Practice for Steel Buildings and Bridges:

“The Owner’s Designated Representative for Construction shall prepare the Embedment Drawing. The Embedment Drawing shall be submitted to the Structural Engineer of Record for information only. The Structural Engineer of Record shall not be responsible for the review and approval of the Embedment Drawing.”

- C. Add the following paragraph to Section 7.10.3 of the AISC Code of Standard Practice for Steel Buildings and Bridges:

“The Erector shall have the sole responsibility for determining the means and methods used to properly and adequately brace the framing during erection.”

- D. Revise the second paragraph of Section 7.10.3 of the AISC Code of Standard Practice for Steel Buildings and Bridges as follows:

“The Erector need not consider loads during erection that result from the performance of work by, or the acts of, others, except as specifically identified by the Owner’s Designated Representatives for Design and Construction, nor those that are unpredictable, such as loads due to hurricane, tornado, ~~earthquake~~, explosion or collision. **The Erector shall determine, furnish and install temporary supports to resist earthquake loads specified by the 2006 International Building Code for new buildings.**”

- E. Revise Section 7.14 of the AISC Code of Standard Practice for Steel Buildings and Bridges as follows:

“The correction of minor misfits by moderate amounts of reaming or grinding, ~~welding or cutting~~, and the drawing of elements into line with drift pins, shall be considered to be normal erection operations. Errors that cannot be corrected using the foregoing means, or that require ~~major~~ **welding, cutting or** changes in member or Connection configuration, shall be promptly reported to the Owner’s Designated Representatives for Design and Construction and the Fabricator by the Erector, to enable the responsible entity to either correct the error or approve the most efficient and economical method of correction to be used by others.”

**Particular note shall be paid to the commentary for this section of the AISC Code of Standard Practice for Steel Buildings and Bridges, which reads as follows:**

“As used in this Section, the term “moderate” refers to the amount of reaming, grinding, welding or cutting that must be done on the project as a whole, not the amount that is required at an individual location. It is not intended to address limitations on the amount of material that is removed by reaming at an individual bolt hole, for example, which is limited by the bolt-hole size and tolerance requirements in the AISC and RCSC Specifications.”

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL-STEEL MATERIALS

- A. Structural Steel Shapes, and Bars. Refer to the General Structural Notes.
- B. Welding Electrodes: Comply with AWS requirements.



1. Welding electrodes shall have a minimum tensile strength of 70 ksi using AWS A5 classification test.
2. Welding filler metals, as supplied by the manufacturer, shall meet the requirements for H16 (16 mL diffusible hydrogen per 100 grams deposited weld metal) as tested using the mercury or gas chromatograph method as specified in AWS A4.3, "Standard Methods for Determination of Diffusible Hydrogen Content of Martensitic, Bainitic, and Ferritic Steel Weld Metal Produced by Arc Welding." The manufacturer's Certificate of Conformance shall be considered adequate proof that the supplied electrodes meet this requirement, and no additional testing of filler metal samples or of production welds is required.
3. All low hydrogen electrodes shall be stored, handled, protected from atmospheric exposure and redried, if required, per AWS D1.1, 5.3.
4. FCAW electrodes shall be received in moisture-resistant packages that are undamaged. They shall be protected against contamination and injury during shipment and storage. Electrode packages shall remain effectively sealed against moisture until the electrode is required for use. When removed from the protective packaging and installed on machines, care shall be taken to protect the electrodes and coatings, if present, from deterioration or damage. Modification or lubrication of an electrode after manufacture for any reason is not permitted, except drying shall be permitted when recommended by the manufacturer.

## 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
  1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

## 2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI #79 and compatible with topcoat.

## 2.4 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" (with exceptions noted in Part 1 of this Specification Section).
  1. Camber structural-steel members where indicated.
  2. Fabricate beams with rolling camber up.
  3. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
  4. Mark and match-mark materials for field assembly.
  5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Re-Entrant Corners: Provide ½-inch radius at all re-entrant corners, unless noted otherwise.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
  1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

- D. Bolt Holes: Cut, drill, or punch bolt holes perpendicular to metal surfaces.
- E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- F. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.5 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. For connections part of the SLRS, comply with additional requirements of AWS D1.8 – seismic supplement.
  - 1. Continuously seal joined members exposed to weather by continuous welds.
- C. Erection Connections, etc: Place holes, plates, or other attachments required by the Erector so as not to interfere with or cause any other detrimental effect to structural members or their connections.

## 2.6 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
  - 2. Surfaces to be field welded.
  - 3. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. SSPC-SP 2, "Hand Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
  - 2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Prepare steel and apply a 1-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

## 2.7 DIMENSIONAL TOLERANCES

- A. Fabrication Tolerances: Unless otherwise noted, fabricate structural members to referenced AISC Specifications for allowable tolerances. Do not camber in excess of amounts shown on drawings.

## 2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.
1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth
  2. Materials for galvanizing shall be geometrically suitable for galvanizing as specified in ASTM A384 and A385.
- B. Steel that will be finished by hot dip galvanizing shall have controlled silicon and phosphorus contents. The silicon content shall be in either of the ranges 0 – 0.04% or 0.15% – 0.25%, the phosphorus content shall be below 0.04%. Before galvanizing, submit mill test certificates verifying silicon and phosphorus contents to the Architect and galvanizer.
- C. Bolts, nuts and washers, and iron and steel hardware components shall be galvanized by the hot-dip process in accordance with ASTM A 153.
- D. Surface Preparation: Steel shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter: Clean steel in accordance with Steel Structures Painting Council (SSPC) SSPC-SP-6, "Commercial Blast Cleaning."
- E. Coating Requirements
1. Weight: The weight of the galvanized coating shall conform to Table 2 of ASTM A 123 or Table 1 of ASTM A 153, as appropriate.
  2. Surface Finish: The galvanized coating shall be continuous, adherent, as smooth and evenly distributed as possible, and free from any defect that is detrimental to the stated end use of the coated article.
    - a. Determine the integrity of the coating by visual inspection and coating thickness measurements.
    - b. Where slip factors are required for slip-critical connections, these shall be obtained after galvanizing by suitable treatment of the faying surfaces in accordance with the latest edition of the Specification for Structural Joints Using ASTM A 325 or A 490 bolts as approved by the Research Council on Structural Connections of the Engineering Foundation.
  3. Adhesion: The galvanized coating shall be sufficiently adherent to withstand normal handling during transport and erection.
- F. Touch-Up and Repair
1. Mechanical Damage: Repair areas damaged by welding; flame cutting; or during handling, transport, or erection in accordance with ASTM A 780 by one of the following methods:
    - a. Cold Galvanizing Compound (zinc-rich paint): Per Part 2, "Primer" Article, in accordance with ASTM A 780, Annex A2.

- 1) Spray- or brush-apply the touch-up paint in multiple coats to a dry film minimum thickness of a 6 mils (4 mils for material less than 1/4-inch thick). Apply a finish coat of aluminum paint to provide a color blend with the surrounding galvanizing.
- 2) Verify coating thickness by measurements with a magnetic or electromagnetic gauge.
- b. Zinc-Based Solder: In accordance with ASTM A 780, Annex A1.
  - 1) Apply the zinc-based solder in a minimum thickness of 4 mils (3 mils for material less than 1/4-inch thick).
  - 2) Verify coating thickness by measurements with a magnetic or electromagnetic gauge.
- c. Flame-Sprayed Zinc (metalizing): In accordance with ASTM A 780, Annex A3.
  - 1) Apply sprayed zinc coating in a minimum thickness of 4 mils (3 mils for material less than 1/4-inch thick).
2. Wet Storage Stain
  - a. Remove any wet storage stain if formed and discovered prior to leaving the galvanizer's plant unless late pick up or acceptance of delivery has necessitated the material being stored in unfavorable conditions. Remove wet storage stain before installation so that premature failure of the coating will not occur. Remove wet storage stain as follows:
    - 1) Arrange the object so that their surfaces dry rapidly.
    - 2) Remove light deposits by means of a stiff bristle (not wire) brush. Heavier deposits are to be removed by brushing with a 5 percent solution of sodium or potassium dichromate with the addition of 0.1 percent by volume of concentrated sulfuric acid. Apply with a stiff bristle brush, and leave for approximately 30 seconds before thoroughly rinsing and drying.
    - 3) Alternatively, a proprietary product, such as Oakite Highlite or equal, which is intended for this purpose, may be used according to manufacturer's recommendations.
    - 4) Check coating thickness in the affected areas to ensure that the zinc coating remaining after the removal of wet storage stain is sufficient to meet or exceed the requirements of the specification.

## 2.9 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspection agency to perform shop tests and inspections and prepare test reports. Personnel inspecting connections part of the SLRS shall be qualified per Section 1.5 of this Specification.
  1. Provide testing agency with access to places where structural steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- D. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
- E. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
  1. Liquid Penetrant Inspection: ASTM E 165

2. Magnetic Particle Inspection: ASTM E 790; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

#### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 "Code of Standard Practice for Steel Buildings and Bridges" with exception noted in Part 1 of this Specification Section, and AISC 360 "Specification for Structural Steel Buildings"..
- B. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  1. Level and plumb individual members of structure.
  2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- C. Splice members only where indicated.
- D. Do not use thermal cutting during erection.
- E. Do not enlarge unfair holes in members by burning or using drift pins.
- F. Reaming: Light drifting will be permitted to draw the parts together, but drifting to match unfair holes will not be permitted. Any enlargement of holes necessary to make connections in the field shall be done by reaming with twist drills, care being taken not to weaken the adjoining metal. If, in the judgement of the Engineer/Architect, the extent of the reaming is such that holes cannot be properly filled or accurately adjusted after reaming, the faulty member shall be discarded and replaced with a new one, and all costs and expenses resulting therefrom shall be paid by the Contractor.

- G. Cutting and Fitting: No cutting of sections, either flanges, webs, stems or angles shall be done by the Contractor without the consent of the Engineer/Architect, unless this cutting is particularly specified or shown on the drawings.
- H. Corrective Measures:
1. Any errors in locations or inaccuracies in the setting of anchor bolts, base plates, bearing plates, or other items of attachment or support for steel work shall be reported to the Engineer/Architect, and shall be corrected in a manner subject to the approval of the Engineer/Architect.
  2. Any misfits due to errors in fabrication shall be reported immediately to the Engineer/Architect, along with proposed method of correction of same and Engineer/Architect approval obtained before proceeding with corrective measures.
  3. No members shall be cut or burned without specific approval in writing.
  4. Bolted or welded connections, joints, or fastenings, which are classified as defective in the opinion of the Engineer/Architect, shall be corrected by the Contractor in a manner subject to the Engineer/Architect's approval.
- I. Guardrails, Handrails and Ladders: All welds and sharp edges shall be ground smooth.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. For connections part of the SLRS, comply with additional requirements of AWS D1.8 – seismic supplement.
1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" (with exceptions noted in Part 1 of this Specification Section) for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
  2. FCAW electrodes shall be protected from atmospheric exposure as follows:
    - a. Electrodes not consumed within 24 hours of accumulated exposure outside closed or heated storage shall not be used for seismic critical welds.
    - b. Electrode spools shall be identified and monitored for total atmospheric exposure time. Electrodes that have been exposed for periods exceeding an accumulated 24 hours may be dried when manufacturer's recommendations show that drying is effective at removing moisture and restoring electrodes to their designated diffusible hydrogen level. Dry as specified by the manufacturer. If the electrode or the electrode spool is damaged by baking, the electrode shall not be used.
  3. Each Welder working on the project shall be assigned an identification symbol or mark. Each Welder shall mark or stamp this identification symbol at each weldment completed and inspected by the welder. Stamps, if used, shall be low-stress type. All welds shall be marked or stamped.
- C. Erection Connections, etc: Place holes, plates, or other attachments required by the Erector so as not to interfere with or cause any other detrimental effect to structural members or their connections.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections and tests and to prepare test reports in accordance with "Testing and Inspection" Article 3.6 below. Personnel inspecting connections part of the SLRS shall be qualified per Section 1.5 of this Specification.
  - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- B. Bolted Connections: Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
  - 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following non-destructive testing (NDT) procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E 165.
    - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    - c. Ultrasonic Inspection: ASTM E 164.
    - d. Radiographic Inspection: ASTM E 94.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- E. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

### 3.6 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint or zinc-based solder according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories and abutting structural steel.
  - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
  - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION 051200

## SECTION 055000 - METAL FABRICATIONS

## 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. Steel framing and supports for parapet bracing.
  - 2. Anchorages for fall restraint system.
  - 3. Steel framing and supports for mechanical and electrical equipment.
  - 4. Metal ladders.
- B. Related Sections:
  - 1. Section 055100 "Metal Ramps."
  - 2. Section 055213 "Pipe and Tube Railings."

## 1.3 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for metal fabrications.
  - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

## 1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

## PART 2 - PRODUCTS

## 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.



## 2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use. Select fasteners for type, grade, and class required.
- B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1 .

## 2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Galvanize miscellaneous framing and supports where indicated.

## 2.7 METAL LADDERS

- A. General:
  - 1. Comply with ANSI A14.3 unless otherwise indicated.
- B. Steel Ladders:
  - 1. Space siderails 16 inches apart unless otherwise indicated.
  - 2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
  - 3. Rungs: 3/4-inch-diameter steel bars.
  - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
  - 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
  - 6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
  - 7. Galvanize exterior ladders, including brackets and fasteners.

## 2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

## 2.9 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning," and SSPC-SP 3, "Power Tool Cleaning."

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

### 3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

### 3.3 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

## SECTION 055100 - METAL RAMPS

## 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. Industrial-type ramp with steel grating platforms.
- B. Related Sections:
  - 1. Section 055213 "Pipe and Tube Railings" for pipe and tube railings.

## 1.3 SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Ramp Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of ramp designated, unless more stringent requirements are indicated.
  - 1. Industrial-Type Ramps: Industrial class.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## 1.5 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal ramps. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

## 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

## 2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- C. Wire Rod for Grating Crossbars: ASTM A 510.

## 2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
  - 1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior ramps .
- D. Machine Screws: ASME B18.6.3.
- E. Lag Screws: ASME B18.2.1.
- F. Plain Washers: Round, ASME B18.22.1.
- G. Lock Washers: Helical, spring type, ASME B18.21.1.

## 2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.5 FABRICATION, GENERAL

- A. Provide complete ramp assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor ramps and platforms on supporting structure.
  - 1. Join components by welding unless otherwise indicated.
  - 2. Use connections that maintain structural value of joined pieces.
  - 3. Fabricate platforms of exterior ramps so finished walking surfaces slope to drain.
- B. Preassembled Ramps: Assemble ramps in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply 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. Weld exposed corners and seams continuously unless otherwise indicated.
  - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

## 2.6 STEEL-FRAMED RAMPS

- A. Ramp Framing:
  - 1. Fabricate stringers of steel channels.
    - a. Provide closures for exposed ends of channel stringers.
  - 2. Construct platforms of steel channel headers and miscellaneous framing members as indicated.
  - 3. Weld stringers to headers; weld framing members to stringers and headers.
- B. Metal Bar-Grating Ramps: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
  - 1. Fabricate platforms from welded steel grating with openings in gratings no more than 1/2 inch in least dimension.

2. Surface: Plain.
3. Finish: Galvanized.
4. Fabricate grating platforms with steel angle or steel plate carrier at each end for stringer connections.
5. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.

## 2.7 RAMP RAILINGS

- A. Comply with applicable requirements in Section 055213 "Pipe and Tube Railings."
  1. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
  2. Connect posts to ramp framing by direct welding unless otherwise indicated.

## 2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal ramps after assembly.
- C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
  2. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- D. Preparation for Shop Priming: Prepare galvanized metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning," and SSPC-SP 3, "Power Tool Cleaning."

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal ramps to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal ramps. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- D. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

3.2 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055100



## SECTION 055213 - PIPE AND TUBE RAILINGS

## 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. Steel pipe railings.

- B. Related Sections:

- 1. Section 055100 "Metal Ramps" for steel tube railings associated with metal stairs.
  - 2. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking for anchoring railings.

## 1.3 ACTION SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

## 1.7 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

## PART 2 - PRODUCTS

### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

### 2.2 STEEL AND IRON

- A. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations and where indicated.

### 2.3 FASTENERS

- A. General: Provide the following:
  - 1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

### 2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Shop Primers: Provide primers that comply with Section 099000 "Exterior Painting".

### 2.5 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
  - C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
  - D. Form work true to line and level with accurate angles and surfaces.
  - E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
  - F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
  - G. Connections: Fabricate railings with welded connections unless otherwise indicated.
  - H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
    - 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 flux immediately.
    - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
  - I. Form changes in direction as follows:
    - 1. By bending.
  - J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
  - K. Close exposed ends of railing members with prefabricated end fittings.
  - L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
  - M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- 2.6 FINISHES, GENERAL
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## 2.7 STEEL AND IRON FINISHES

- A. Galvanized Railings:
  - 1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
  - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
  - 3. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
  - 4. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
- E. Shop-Painted Finish: Comply with Section 099000 "Exterior Painting."
  - 1. Color: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

### 3.2 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

### 3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting"
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.4 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

## SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

## 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. Rooftop equipment bases and support curbs.
  - 2. Wood blocking and nailers.

## 1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  - 1. WCLIB: West Coast Lumber Inspection Bureau.
  - 2. WWPA: Western Wood Products Association.

## 1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
  - 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
  - 1. Preservative-treated wood.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

## 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  - 3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

## 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC3b for exterior construction not in contact with the ground.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all miscellaneous carpentry unless otherwise indicated.
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

## 2.3 LUMBER MATERIALS

- A. General: Provide lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
  - 3. Rooftop equipment bases and support curbs.
- B. For items of dimension lumber size, provide No. 2 or bettergrade lumber of the following species:
  - 1. Douglas fir larch; WCLIB or WWPA.
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

## 2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
  - 1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Do not splice structural members between supports unless otherwise indicated.
- D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.
- F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.



- G. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

END OF SECTION 061053

## SECTION 070150 - PREPARATION FOR RE-ROOFING

## 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. Roof tear-off.
- 2. Removal of base flashings.

- B. Related Sections:

- 1. Section 011000 "Summary" for use of the premises and phasing requirements.
- 2. Section 015000 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for reroofing preparation.

## 1.3 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

## 1.4 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Existing Membrane Roofing System: EPDM roofing membrane, roof insulation, ballast, surfacing, and components and accessories between deck and roofing membrane.
- C. Roof Tear-Off: Removal of existing membrane roofing system from deck.
- D. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and reinstalled.
- E. Existing to Remain: Existing items of construction that are not indicated to be removed.

## 1.5 SUBMITTALS

- A. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by reroofing operations. Submit before Work begins.

## 1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning membrane roofing removal. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Reroofing Conference: Conduct conference at Project site.
  - 1. Meet with Owner; Architect; Owner's insurer if applicable; testing and inspecting agency representative; roofing system manufacturer's representative; deck Installer; roofing Installer including project manager, superintendent, and foreman; and installers whose work interfaces with or affects reroofing including installers of roof accessories and roof-mounted equipment.
  - 2. Review methods and procedures related to roofing system tear-off and replacement including, but not limited to, the following:
    - a. Reroofing preparation, including membrane roofing system manufacturer's written instructions.
    - b. Temporary protection requirements for existing roofing system that is to remain during installation.
    - c. Existing roof drains and roof drainage during each stage of reroofing, and roof drain plugging and plug removal requirements.
    - d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - e. Existing deck removal procedures and Owner notifications.
    - f. Condition and acceptance of existing roof deck and base flashing substrate for reuse.
    - g. Structural loading limitations of deck during reroofing.
    - h. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that will affect reroofing.
    - i. HVAC shutdown and sealing of air intakes.
    - j. Shutdown of fire-suppression, -protection, and -alarm and -detection systems.
    - k. Asbestos removal and discovery of asbestos-containing materials.
    - l. Governing regulations and requirements for insurance and certificates if applicable.
    - m. Existing conditions that may require notification of Architect before proceeding.
    - n. Effects of roof work on spaces below: including but not limited to noise, odors and dislodged debris.

## 1.7 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately below reroofing area. Conduct reroofing so Owner's operations will not be disrupted. Provide Owner with not less than 72 hours' notice of activities that may affect Owner's operations.
  - 1. Coordinate work activities daily with Owner so Owner can place protective dust or water leakage covers over sensitive equipment or furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below the work area.
- B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- D. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.

- E. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.
- F. Hazardous Materials: It is not expected that hazardous materials such as asbestos-containing materials will be encountered in the Work.
  - 1. A report on the presence of hazardous materials is provided in an appendix to the specifications.
  - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

## PART 2 - PRODUCTS

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.
- B. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- C. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
  - 1. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new membrane roofing system, provide alternative drainage method to remove water and eliminate ponding.
- D. Verify that rooftop utilities and service piping have been shut off before beginning the Work.

### 3.2 ROOF TEAR-OFF

- A. General: Notify Owner each day of extent of roof tear-off proposed for that day.
- B. Remove aggregate ballast from roofing membrane.
- C. Remove walk pads and accessories from roofing membrane.
- D. Roof Tear-Off: Remove existing roofing membrane, insulation and other membrane roofing system components down to the deck.

### 3.3 DECK PREPARATION

- A. Inspect deck after tear-off of membrane roofing system.

- B. If deck surface is not suitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect. Do not proceed with installation until directed by Architect.

### 3.4 EXISTING BASE FLASHINGS

- A. Remove existing base flashings around parapets, curbs, walls, and penetrations.
  - 1. Clean substrates of contaminants such as asphalt, sheet materials, dirt, and debris.
- B. Do not damage metal counterflashings that are to remain. Replace metal counterflashings damaged during removal with counterflashings specified in Section 076200 "Sheet Metal Flashing and Trim."

### 3.5 DISPOSAL

- A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
  - 1. Storage or sale of demolished items or materials on-site is not permitted.
- B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION 070150

## SECTION 071413 - HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING

## 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. Hot fluid-applied rubberized-asphalt waterproofing membrane system, reinforced.
  - 2. Drainage Mat
  - 3. Insulation/pavers
- B. Related Sections:
  - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs and blocking.
  - 2. Section 070150 "Preparation for Re-Roofing" for roof tear-off and preparation.
  - 3. Section 024119 "Selective Structure Demolition" for demolition and removal of selected portions of building.
  - 4. Section 076200 "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings and counterflashings.

## 1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed waterproofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane waterproofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide waterproofing materials that are compatible with one another under conditions of service and application required, as demonstrated by waterproofing manufacturer based on testing and field experience.
- C. Waterproofing System Design: Provide waterproofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
  - 1. As noted on Drawings.
- D. Testing Laboratory Compliance: Provide roof system that complies with Underwriters Laboratory (U.L) or equivalent compliance from an approved laboratory.
  - 1. Provide roof system compliance of U.L. 790 Class A.

## 1.4 SYSTEM DESCRIPTION

- A. Existing concrete roof deck.

- B. Primer coat.
- C. 215 mil, Multi-layered, Fabric-Reinforced, Hot Rubberized Asphalt Waterproofing Membrane.
- D. Protection course, SBS Bitumen Modified
- E. Drainage Mat
- F. Rigid Insulation
- G. Insulated paver board composite panels
- H. Elastomeric Flashings
- I. Sheet Metal Flashings

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Samples: For the following products in manufacturer's standard sizes unless otherwise indicated (6"x6"):
  - 1. Flashing sheet.
  - 2. Cured membrane assembly section
  - 3. Membrane-reinforcing fabric.
  - 4. Drainage mat
  - 5. Insulated paver board
- C. Qualification Data: For qualified Installer and Manufacturer.
- D. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.
- E. Warranties: Sample of special warranties and final Warranty documentation.
- F. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, supplementary instructions given, and any adverse conditions or workmanship that could affect quality of roofing system.
- G. Manufacturer's Project Close-Out Report: Include Project specifications, project summary, field reports, job progress photos, Warranty document, Owner's Manual describing maintenance and emergency repair.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is approved or licensed by manufacturer for installation of waterproofing required for this Project and is eligible to receive special warranties specified.
  - 1. Installer must have been and continue to be in operation under current business name and structure continuously for the last five years.
  - 2. Installer must have minimum of ten projects experience in hot fluid-applied rubberized asphalt roofing systems.

- B. **Manufacturer Qualifications:** A qualified manufacturer that has UL listing for roofing system identical to that used for this Project.
  - 1. Manufacturer must be an associate member in good standing with National Roofing Contractor's Association continuously for the past five years.
  - 2. Manufacturer must employ a full-time Field Technical Services Representative, available for monitoring project work.
  - 3. Manufacturer must have completed minimum of 3 projects in the states of Oregon and/or Washington with the roofing system specified in this section.
  - 4. Manufacturer must have a documented certification program for installers which requires a specified amount of training.
- C. **Source Limitations:** Obtain waterproofing materials, sheet flashings, and protection course from single source from single manufacturer.
- D. **Preinstallation Conference:** Conduct conference at Project site .
  - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.
- E. **Mockups:** Install waterproofing to 100 sq. ft. of deck and wall to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality. Install pavers and ballast to demonstrate aesthetic affects and set quality standards for materials and execution.
  - 1. If Architect determines mockups do not comply with requirements, reapply waterproofing and reinstall overlaying construction until mockups are approved.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. **Progress Inspections:** Provide a minimum of one inspection per week by roofing manufacturer's technical representative/service inspector. Additional inspections may be required as determined by the scope of the work.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Protect stored materials from direct sunlight.

#### 1.8 PROJECT CONDITIONS

- A. **Environmental Limitations:** Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below 0 deg F.
  - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during application and curing of waterproofing materials.



## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period.
1. Special warranty to include waterproofing membrane, base flashings, metal flashings and counter flashings in contact with waterproofing system, accessories, insulation, fasteners and other components of waterproofing system.
  2. Warranty insulation will retain 80 percent of original published thermal value.
  3. Warranty pavers will not dish or warp and will not crack, split, or disintegrate in freeze-thaw conditions.
  4. Warranty includes removing and reinstalling protection board, drainage panels, insulation, strapping and flashing.
  5. Warranty does not include failure of roofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/8 inch (3 mm) in width.
  6. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Installer's Warranty: Specified form signed by Installer, covering Work of this Section, for warranty period of three years.
1. Special warranty to include waterproofing membrane, base flashings, metal flashings and counter flashings in contact with waterproofing system, accessories, insulation, fasteners and other components of waterproofing system.
  2. Warranty pavers will not dish or warp and will not crack, split, or disintegrate in freeze-thaw conditions.
  3. Warranty includes removing and reinstalling protection board, drainage panels, insulation, strapping and flashing.

## PART 2 - PRODUCTS

## 2.1 WATERPROOFING MEMBRANE

- A. Hot Fluid-Applied, Rubberized-Asphalt Waterproofing Membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. American Hydrotech, Inc.; Monolithic Membrane 6125-EV.
    - b. Henry Company; 790-11-EV.
    - c. Tremco Incorporated; TREMproof 6100
    - d. Approved substitution.
  2. Minimum physical and performance properties according to CAN/CGSB-37.50 as follows:
    - a. Flash Point: Not less than 260 deg C or not less than 25 deg C above manufacturer's maximum recommended application temperature.
    - b. Cone Penetration: 110 maximum at 25 deg C, and 200 maximum at 50 deg C.
    - c. Flow: 3 mm maximum at 60 deg C.
    - d. Toughness: Not less than 5.5 J
    - e. Ratio of Toughness to Peak Load: Not less than 0.040.
    - f. Adhesion Rating: Pass.
    - g. Water-Vapor Permeance: 1.7 ng/Pa x s x sq. m.
    - h. Water Absorption: 0.35-g maximum mass gain, or 0.18-g maximum mass loss.
    - i. Pinholing: Not more than one pinhole.
    - j. Low-Temperature Flexibility: No cracking.

- k. Crack Bridging Capability: No cracking, splitting, or loss of adhesion.
- l. Heat Stability: Comply with requirements for penetration, flow, low-temperature flexibility, and viscosity when heated for five hours at manufacturer's recommended application temperature.
- m. Viscosity Test: 2 to 15 seconds.

## 2.2 FLASHING SHEET MATERIALS

- A. Elastomeric Flashing Sheet: 50-mil minimum, uncured sheet neoprene as follows:
  - 1. Tensile Strength: 1400 psi minimum; ASTM D 412, Die C.
  - 2. Elongation: 300 percent minimum; ASTM D 412.
  - 3. Tear Resistance: 125 psi minimum; ASTM D 624, Die C.
  - 4. Brittleness: Does not break at minus 30 deg F; ASTM D 2137.

## 2.3 AUXILIARY MATERIALS

- A. Primer: ASTM D 41, asphaltic primer.
- B. Elastomeric Sheet: 50-mil- minimum, uncured sheet neoprene as follows:
  - 1. Tensile Strength: 1400 psi minimum; ASTM D 412, Die C.
  - 2. Elongation: 300 percent minimum; ASTM D 412.
  - 3. Tear Resistance: 125 psi minimum; ASTM D 624, Die C.
  - 4. Brittleness: Does not break at minus 30 deg F; ASTM D 2137.
- C. Sealants and Accessories: Manufacturer's recommended sealants and accessories.
- D. Reinforcing Fabric: Manufacturer's recommended, spun-bonded polyester fabric.
- E. Protection Course: Manufacturer's standard, 80- to 90-mil- thick, fiberglass-reinforced rubberized asphalt or modified bituminous sheet.
- F. Roof Penetration Boots and Jacks: Provide those recommended by roofing system manufacturer, as appropriate and compatible with roofing membrane system.

## 2.4 INSULATION / INSULATED COMPOSITE PAVER BOARD

- A. Insulated Paver Board: Composite panel of 3/8" thick latex modified concrete permanently bonded to 2 inch thick polystyrene board insulation. Type VI, 40-psi minimum compressive strength. 24 x 48 inch board size, with T & G edges. R-10.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Light Guard insulation panels by T-Clear.
    - b. Approved substitution
  - 2. Accessories: Provide manufacturer's recommended hold-down clips and straps. Provide stainless steel clips and straps.

- B. Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type VI, 40-psi minimum compressive strength; unfaced; fabricated with shiplapped or channel edges. R-10. Insulation boards to have integral drainage channels.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company (The); Styrofoam Roofmate.
    - b. Owens Corning; Foamular 404 .
    - c. Approved substitution.

## 2.5 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with waterproofing.
- B. Filter Fabric: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by waterproofing system manufacturer for application.

## 2.6 BALLAST

- A. Salvaged Aggregate Ballast:
  - 1. Salvage existing aggregate ballast that meets minimum size requirements of new aggregate ballast.
  - 2. Clean salvaged ballast of organic material and debris prior to re-application.
- B. New Aggregate Ballast: Washed, smooth stone that will withstand weather exposure without significant deterioration and will not contribute to membrane degradation; of the following size:
  - 1. Size: ASTM D 448, Size 4, ranging in size from 3/4 to 1-1/2 inches (19 to 38 mm).

## 2.7 DRAINAGE MAT

- A. High compressive strength drainage mat system. Polypropylene core to contain vertical cones that permit one-sided drainage. Triple spun bonded 100% polypropylene filter fabric is bonded to the top of the core.
  - 1. Thickness: 0.4 inches, ASTM D 1777
  - 2. Compression (psf): 15,000, ASTM D 1621, compatible with system components.
  - 3. Flow (gal/min/sf): 18, ASTM D 4716
  - 4. Weight: (lbs/sq ft): 0.2
- B. Accessories: manufacturer's recommend tape to join mat panels.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and prepare substrates according to manufacturer's written instructions and ASTM D 4258. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
  - 1. If required by membrane manufacturer, abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove deleterious material to provide a sound surface free of asphalt, coal tar, laitance, glaze, efflorescence, curing compounds, and other non-acceptable materials. Remove remaining loose material and clean surfaces according to ASTM D 4258.
- E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

### 3.3 JOINTS, CRACKS, AND TERMINATIONS

- A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.
  - 1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
  - 2. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet a minimum of 6 inches on each side of moving joints and cracks or joints and cracks exceeding 1/8 inch thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.
  - 3. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum of 6 inches on each side of nonmoving joints and cracks not exceeding 1/8 inch thick, and beyond roof drains and penetrations.
- B. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric sheet extended a minimum of 6 inches on each side of joints and adhere to substrates in a layer of hot rubberized asphalt. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.

### 3.4 FLASHING INSTALLATION

- A. Install elastomeric flashing sheets at terminations of waterproofing membrane according to manufacturer's written instructions.
- B. Prime substrate with asphalt primer.
- C. Install elastomeric flashing sheet and adhere to deck and wall substrates in a layer of hot rubberized asphalt.

- D. Extend elastomeric flashing sheet up walls or parapets as indicated on Drawings and 6 inches onto deck to be waterproofed.

### 3.5 MEMBRANE APPLICATION

- A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow to dry.
- B. Heat and apply rubberized asphalt according to manufacturer's written instructions.
  - 1. Heat rubberized asphalt in an oil- or air-jacketed melted with mechanical agitator specifically designed for heating rubberized asphalt.
- C. Start application with manufacturer's authorized representative present.
- D. Reinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to a thickness of 90 mils; embed reinforcing fabric, overlapping sheets 2 inches; spread another 125-mil- thick layer to provide a uniform, reinforced, seamless membrane 215 mils thick.
- E. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.
- F. Cure membrane per membrane manufacturer's instructions.
- G. Cover waterproofing with protection course with joints overlapped a minimum of 2 inches before membrane is subject to construction traffic.

### 3.6 DRAINAGE MAT INSTALLATION

- A. Install drainage mat per manufacturer's written instructions; Install with drain holes down so mat does not collect water.

### 3.7 INSULATION INSTALLATION

- A. Install one layer of insulation drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch of projections and penetrations.
- B. Loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- C. Install insulation with joints of each succeeding layer staggered over joints of previous layer a minimum of 6 inches in each direction.

### 3.8 PAVER BOARD INSTALLATION

- A. Install insulation paver board panels over entire roof areas indicated. Install in accordance with manufacturer's written instructions.
- B. Provide strapping per requirements for applicable installation zone.

## 3.9 BALLAST INSTALLATION

- A. Install filter fabric over insulation, overlapping edges and ends at least 12 inches. Do not lap ends of fabric sheets within 72 inches of roof perimeter. Extend fabric 2 to 3 inches above ballast at perimeter and penetrations. Apply additional layer of fabric around penetrations to prevent aggregate from getting between penetration and insulation. Do not cover drains or restrict water flow to drains.
- B. To areas indicated, apply salvaged and new aggregate ballast uniformly over filter fabric at rate required by insulation manufacturer, but not less than the following, carefully spreading aggregate to not damage roofing membrane and base flashings. Apply ballast as insulation is installed, leaving roofing membrane insulated and ballasted at end of workday.
  - 1. Ballast: 12 lb/sq. ft., Size 4 aggregate.

## 3.10 FIELD QUALITY CONTROL

- A. Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation; and application of the membrane, flashings, protection, and drainage components and to conduct field adhesion testing; furnish daily reports to Architect.
- B. Flood Testing: Flood test each roof area for leaks, according to recommendations in ASTM D 5957, after completing and protecting waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
  - 1. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of sheet flashings.
  - 2. Flood each area for 48 hours.
  - 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
- C. Owner will engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.

## 3.11 CLEANING AND PROTECTION

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Protect installed board insulation and insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071413

## SECTION 075216 - SBS MODIFIED BITUMINOUS MEMBRANE ROOFING

## 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. Styrene-butadiene-styrene (SBS) modified bituminous membrane roofing.
  - 2. Roof insulation.
- B. Related Sections:
  - 1. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing and trim integral with roofing.

## 1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

## 1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
  - 1. As noted on Drawings.
- D. Testing Laboratory Compliance: Provide roof system that complies with Underwriters Laboratory (U.L.) or equivalent compliance form an approved laboratory.
  - 1. Provide roof system compliance of U.L. 790 Class A.
- E. Energy Performance: Provide roofing system that is listed on DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For adhesives and sealants used inside the weatherproofing system, documentation including printed statement of VOC content.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Base flashings and membrane terminations.
  - 2. Tapered insulation, including slopes.
  - 3. Crickets, saddles, and tapered edge strips, including slopes.
  - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Samples for Verification: For the following products:
  - 1. Sheet roofing materials, including base sheet roofing membrane sheet flashing backer sheet membrane cap sheet and flashing sheet, of color specified.
  - 2. Roof insulation.
  - 3. Walkway pads or rolls.
  - 4. Six insulation fasteners of each type, length, and finish.
- D. Qualification Data: For qualified Installer and manufacturer .
- E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
  - 1. Submit evidence of complying with performance requirements.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- G. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES .
- H. Warranties: Sample of special warranties.
- I. Manufacturer's Field Reports: Prepared by manufacturer's Field Technical Representative. Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, supplementary instructions given, and any adverse conditions or workmanship that could affect quality of roofing system.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Source Limitations: Obtain components including roof insulation and fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- D. Exterior Fire-Test Exposure: ASTM E 108, Class A ; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.



- E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - F. Preinstallation Roofing Conference: Conduct conference at Project site.
    - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
    - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
    - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
    - 5. Review structural loading limitations of roof deck during and after roofing.
    - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
    - 7. Review governing regulations and requirements for insurance and certificates if applicable.
    - 8. Review temporary protection requirements for roofing system during and after installation.
    - 9. Review roof observation and repair procedures after roofing installation.
  - G. Mockups: Install waterproofing to 100 sq. ft. of deck and wall to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality. Install pavers and ballast to demonstrate aesthetic affects and set quality standards for materials and execution.
    - 1. If Architect determines mockups do not comply with requirements, reapply waterproofing and reinstall overlaying construction until mockups are approved.
    - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
    - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
  - H. Manufacturer's Project Close-Out Report: Prepared by manufacturer's Field Technical Representative. Include project specifications, project summary, progress reports, job progress photos, warranty document and owner's manual describing maintenance and repair.
  - I. Progress Inspections: Provide a minimum of one inspection per week by roofing manufacturer's technical representative/service inspector. Additional inspections may be required as determined by the scope of the work.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
  - B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
    - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
  - C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

## 1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, adhesives and other components of membrane roofing system.
  - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:
  - 1. Warranty Period: Three years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SBS-MODIFIED ASPHALT-SHEET MATERIALS

- A. SBS-Modified Bituminous Membrane Roofing:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or as approved.
    - a. Firestone Building Products.
    - b. Johns Manville.
    - c. Malarkey Roofing Company
    - d. Tremco Incorporated.
    - e. Siplast, Inc.
- B. Roofing Membrane Sheet: ASTM D 6163, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers); smooth surfaced; suitable for application method specified.
- C. Granule-Surface Roofing Membrane Cap Sheet: ASTM D 6163, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers) granular surfaced; suitable for application method specified, and as follows:
  - 1. Granule Color: Ultra White, meeting ENERGYSTAR emissivity and reflectivity requirements.

## 2.2 BASE-SHEET MATERIALS

- A. Base Sheet: ASTM D 4601, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

## 2.3 BASE-PLY SHEET MATERIALS

- A. Glass-Fiber Base-Ply Sheet: ASTM D 2178, Type IV asphalt-impregnated, glass-fiber or polyester/glass-fiber felt.

## 2.4 BASE FLASHING SHEET MATERIALS

- A. Backer Sheet: ASTM D 6164, ASTM D 6163, ASTM D 6162 Grade S, Type I or II, SBS-modified asphalt sheet, smooth surfaced; suitable for application method specified.
- B. Elastomeric Flashing Sheet: 50-mil minimum, uncured sheet neoprene as follows:
  - 1. Tensile Strength: 1400 psi minimum; ASTM D 412, Die C.
  - 2. Elongation: 300 percent minimum; ASTM D 412.
  - 3. Tear Resistance: 125 psi minimum; ASTM D 624, Die C.
- C. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D 1668, Type I.
- D.

## 2.5 AUXILIARY ROOFING MEMBRANE MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.
  - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
  - 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Plastic Foam Adhesives: 50 g/L.
    - b. Gypsum Board and Panel Adhesives: 50 g/L.
    - c. Multipurpose Construction Adhesives: 70 g/L.
    - d. Fiberglass Adhesives: 80 g/L.
    - e. Contact Adhesive: 80 g/L.
    - f. Other Adhesives: 250 g/L.
    - g. Nonmembrane Roof Sealants: 300 g/L.
    - h. Sealant Primers for Nonporous Substrates: 250 g/L.
    - i. Sealant Primers for Porous Substrates: 775 g/L.
  - 3. Adhesives and sealants that are not on the exterior side of weather barrier 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. Asphalt Primer: ASTM D 41.

- C. Cold-Applied Adhesive: Roofing system manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with roofing membrane and base flashings.
- D. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.
- E. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing membrane components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- G. Metal Flashing Sheet: As specified in Section 076200 "Sheet Metal Flashing and Trim."
- H. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained on No. 40 sieve, color to match roofing membrane.
- I. Aggregate Surfacing: ASTM D 1863, No. 6 or No. 67, clean, dry, opaque, water-worn gravel or crushed stone, free of sharp edges.
- J. Roof Penetration Boots and Jacks: Provide those recommended by roofing system manufacturer, as appropriate and compatible with roofing membrane system.
- K. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

## 2.6 VAPOR RETARDER

- A. Glass-Fiber Felt: ASTM D 2178, Type IV, asphalt impregnated.

## 2.7 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured, or approved, by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class I, Grade 3, felt or glass-fiber mat facer on both major surfaces.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

## 2.8 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Modified Asphaltic Insulation Adhesive: Insulation manufacturer's recommended modified asphaltic, asbestos-free, cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- D. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- E. Insulation Cant Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
- F. Wood Nailer Strips: Comply with requirements in Section 061053 "Rough Carpentry."
- G. Tapered Edge Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.
- H. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 5/8 inch thick, factory primed.
  - 1. Products: Subject to compliance with requirements:
    - a. Georgia-Pacific Corporation; Dens Deck
    - b. or approved
- I. Substrate Joint Tape: 6- or 8-inch- wide, coated, glass-fiber joint tape.

## 2.9 WALKWAYS

- A. Walkway Pads: Polymer-modified, reconstituted rubber pads with slip-resisting textured surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 3/8 inch thick, minimum.
  - 1. Pad Size: 24" x 30"
  - 2. As approved

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
  - 2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
  - 4. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

- a. Test for moisture by pouring 1 pint of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane. Do not proceed with roofing work if test sample foams or can be easily and cleanly stripped after cooling.
  5. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
  6. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Prime surface of concrete deck with primer as required by manufacturer.
- D.

### 3.3 VAPOR-RETARDER INSTALLATION

- A. Laminate Sheet: Install laminate-sheet vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches and 6 inches, respectively. Bond vapor retarder to substrate as follows:
  1. Apply adhesive at rate recommended by vapor-retarder manufacturer. Seal laps with adhesive.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

### 3.4 INSULATION INSTALLATION

- A. Comply with roofing system manufacturer's written instructions for installing roof insulation.
- B. Install one lapped base-sheet course and mechanically fasten to substrate according to roofing system manufacturer's written instructions.
- C. Nailer Strips: Mechanically fasten 4-inch nominal- width wood nailer strips of same thickness as insulation at all insulation edges or as required by manufacturer.
- D. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane system with vertical surfaces or angle changes more than 45 degrees.
- E. Install tapered insulation under area of roofing to conform to slopes indicated.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
  1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

- G. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or more, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
  - 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- H. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- I. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- J. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
  - 1. Apply adhesive per manufacturers recommended procedures.
- K. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints a minimum of 6 inches in each direction from joints of insulation below. Loosely butt cover boards together and adhere to roof insulation. Tape joints if required by roofing system manufacturer.
  - 1. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
  - 2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
  - 3. Apply adhesive per manufacturers recommended procedures.

### 3.5 ROOFING MEMBRANE INSTALLATION, GENERAL

- A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
  - 1. Install roofing system according to roof assembly identification matrix and roof assembly layout illustrations in NRCA's "The NRCA Roofing and Waterproofing Manual" and to requirements in this Section.
- B. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing" and as follows:
  - 1. Deck Type: C (concrete or nonnailable)
  - 2. Adhering Method: L -cold-applied adhesive
  - 3. Base Sheet: One
  - 4. Number of Glass-Fiber Base-Ply Sheets: Two
  - 5. Number of SBS-Modified Asphalt Cap Sheets: One
  - 6. Surfacing Type: M (mineral-granule-surfaced cap sheet) ENERGYSTAR
- C. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- D. Where roof slope exceeds 1/2 inch per 12 inches install roofing membrane sheets parallel with slope.
  - 1. Backnail roofing membrane sheets to nailer strips according to roofing system manufacturer's written instructions.
- E. Cooperate with testing agencies engaged or required to perform services for installing roofing system.
- F. Coordinate installation of roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. At end of each day's work, provide tie-offs to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

G. Asphalt Heating: Do not use heated asphalt.

H. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

### 3.6 BASE-SHEET INSTALLATION

A. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches and 6 inches, respectively.

B. Install lapped base-sheet course, extending sheet over and terminating beyond cants. Attach base sheet as follows:

1. Adhere to substrate in a uniform coating of cold-applied adhesive.

### 3.7 BASE-PLY SHEET INSTALLATION

A. Install glass-fiber base-ply sheets according to roofing system manufacturer's written instructions starting at low point of roofing system. Align glass-fiber base-ply sheets without stretching. Extend sheets over and terminate beyond cants.

1. Shingle side laps of glass-fiber base-ply sheets uniformly to ensure that required number of glass-fiber base-ply sheets covers substrate at any point. Shingle in direction to shed water.
2. Embed each glass-fiber base-ply sheet in a continuous void-free mopping of cold-applied roofing asphalt to form a uniform membrane without glass-fiber base-ply sheets touching.

### 3.8 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

A. Install modified bituminous roofing membrane cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:

1. Adhere to substrate in cold-applied adhesive.
2. Unroll roofing membrane sheets and allow them to relax for minimum time period required by manufacturer.

B. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.

1. Repair tears and voids in laps and lapped seams not completely sealed.
2. Apply roofing granules to cover exuded bead at laps while bead is hot.

C. Install roofing membrane sheets so side and end laps shed water.

D. Aggregate Surfacing: Promptly after installing and testing roofing membrane, base flashing, and stripping, flood-coat roof surface with 60 lb/100 sq. ft. of hot roofing asphalt. While flood coat is hot and fluid, cast the following average weight of aggregate in a uniform course:

1. Aggregate Weight: 400 lb/100 sq. ft.



### 3.9 FLASHING AND STRIPPING INSTALLATION

- A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions, and as follows:
  - 1. Prime substrates with asphalt primer if required by roofing system manufacturer.
  - 2. Backer Sheet Application – Mechanically Fastened: Mechanically fasten backer sheet to walls or parapets. Adhere backer sheet over roofing membrane at cants in cold-applied adhesive.
  - 3. Backer Sheet Application - Adhered: Adhere backer sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.
  - 4. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.
- B. Extend base flashing up walls or parapets a minimum of 8 inches above roofing membrane and 4 inches onto field of roofing membrane.
- C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
  - 1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.
- D. Install roofing membrane cap-sheet stripping where metal flanges and edgings are set on membrane roofing according to roofing system manufacturer's written instructions.
- E. Roof Drains: Set 30-by-30-inch square metal flashing in bed of asphalt roofing cement on completed roofing membrane. Cover metal flashing with roofing membrane cap-sheet stripping and extend a minimum of 6 inches beyond edge of metal flashing onto field of roofing membrane. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
  - 1. Install stripping according to roofing system manufacturer's written instructions.

### 3.10 WALKWAY INSTALLATION

- A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size according to walkway pad manufacturer's written instructions.
  - 1. Set walkway pads in cold-applied adhesive.

### 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports.
- B. Test Cuts: Test specimens will be removed to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:
  - 1. Approximate quantities of components within roofing membrane will be determined according to ASTM D 3617.
  - 2. Test specimens will be examined for interply voids according to ASTM D 3617 and to comply with criteria established in Appendix 3 in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
  - 3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
  - 1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

- D. Roofing system will be considered defective if it does not pass tests and inspections.
  - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

### 3.12 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075216

## SECTION 075556 - COLD FLUID-APPLIED ELASTOMERIC WATERPROOFING

## 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. Cold fluid-applied elastomeric waterproofing membrane system, reinforced.
2. Insulation.
3. Drainage Mat
4. Insulation / Paver Composition Board

## B. Related Sections:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs and blocking.
2. Section 070150 "Preparation for Re-Roofing" for roof tear-off and preparation.
3. Section 024119 "Selective Structure Demolition" for demolition and removal of selected portions of building.
4. Section 076200 "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings and counterflashings.

## 1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed waterproofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane waterproofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide waterproofing materials that are compatible with one another under conditions of service and application required, as demonstrated by waterproofing manufacturer based on testing and field experience.
- C. Waterproofing System Design: Provide waterproofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7 for design pressures indicated on Drawings.

## 1.4 SYSTEM DESCRIPTION

- A. Existing concrete roof deck.
- B. Primer coat.

- C. 215 mil, Multi-layered, Fabric Reinforced, One or Multi - Component Elastomeric, Solvent Free, Waterproofing Membrane.
- D. Protection Course
- E. Drainage Mat
- F. Rigid drainable insulation.
- G. Insulation / Paver Composition Board
- H. Elastomeric Flashings
- I. Sheet Metal Flashings

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Samples: For the following products in manufacturer's standard sizes unless otherwise indicated:
  - 1. Flashing sheet.
  - 2. Membrane-reinforcing fabric.
  - 3. Drainage Mat
  - 4. Roof paver.
- C. Qualification Data: For qualified Installer and Manufacturer.
- D. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.
- E. Warranties: Sample of special warranties and final Warranty documentation.
- F. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, supplementary instructions given, and any adverse conditions or workmanship that could affect quality of roofing system.
- G. Manufacturer's Project Close-Out Report: Include Project specifications, project summary, field reports, job progress photos, Warranty document, Owner's Manual describing maintenance and emergency repair.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is approved or licensed by manufacturer for installation of waterproofing required for this Project and is eligible to receive special warranties specified.
  - 1. Installer must have been and continue to be in operation under current business name and structure continuously for the last five years.
  - 2. Installer must have minimum of ten projects experience in cold applied roofing systems.
- B. Manufacturer Qualifications: A qualified manufacturer that has UL listing for roofing system identical to that used for this Project.

1. Manufacturer must be an associate member in good standing with National Roofing Contractor's Association continuously for the past five years.
  2. Manufacturer must employ a full-time Field Technical Services Representative, available for monitoring project work.
  3. Manufacturer must have completed minimum of 3 projects in the states of Oregon and/or Washington with the roofing system specified in this section.
  4. Manufacturer must have a documented certification program for installers which requires a specified amount of training.
- C. Source Limitations: Obtain waterproofing materials, sheet flashings, and protection course from single source from single manufacturer.
- D. Preinstallation Conference: Conduct conference at Project site .
1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.
- E. Mockups: Install waterproofing to 100 sq. ft. of deck and wall to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality. Install pavers and ballast to demonstrate aesthetic affects and set quality standards for materials and execution.
1. If Architect determines mockups do not comply with requirements, reapply waterproofing and reinstall overlaying construction until mockups are approved.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Progress Inspections: Provide a minimum of one inspection per week by roofing manufacturer's technical representative/service inspector. Additional inspections may be required as determined by the scope of the work.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Protect stored materials from direct sunlight.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.

1. Do not apply waterproofing in snow, rain, fog, or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

## 1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period.

1. Special warranty to include waterproofing membrane, base flashings, metal flashings and counter flashings in contact with waterproofing system, accessories, insulation, fasteners and other components of waterproofing system.
2. Warranty insulation will retain 80 percent of original published thermal value.
3. Warranty pavers will not dish or warp and will not crack, split, or disintegrate in freeze-thaw conditions.
4. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pedestal-mounted pavers on plaza decks.
5. Warranty does not include failure of roofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/8 inch (3 mm) in width.
6. Warranty Period: 20 years from date of Substantial Completion.

B. Special Installer's Warranty: Specified form signed by Installer, covering Work of this Section, for warranty period of three years.

1. Special warranty to include waterproofing membrane, base flashings, metal flashings and counter flashings in contact with waterproofing system, accessories, insulation, fasteners and other components of waterproofing system.
2. Warranty pavers will not dish or warp and will not crack, split, or disintegrate in freeze-thaw conditions.
3. Warranty includes removing and reinstalling protection board, drainage panels, insulation, strapping and flashing.

## PART 2 - PRODUCTS

### 2.1 WATERPROOFING MEMBRANE

A. Cold Fluid-Applied, Elastomeric Waterproofing Membrane: Single or Multi - component; ~~moisture cure~~, solvent free waterproofing membrane.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. American Hydrotech, Inc.; Liquid Membrane 6090
  - b. Henry Company; CM100
  - c. Tremco Incorporated; TREMproof 250GC
  - d. Approved substitution.
2. Minimum physical and performance properties according to CAN/CGSB-37.50 as follows:

- a. Flash Point: Not less than 260 deg C or not less than 25 deg C above manufacturer's maximum recommended application temperature.
- b. Cone Penetration: 110 maximum at 25 deg C, and 200 maximum at 50 deg C.
- c. Flow: 3 mm maximum at 60 deg C.
- d. Toughness: Not less than 5.5 J
- e. Ratio of Toughness to Peak Load: Not less than 0.040.
- f. Adhesion Rating: Pass.
- g. Water-Vapor Permeance: 1.7 ng/Pa x s x sq. m.
- h. Water Absorption: 0.35-g maximum mass gain, or 0.18-g maximum mass loss.
- i. Pinholing: Not more than one pinhole.
- j. Low-Temperature Flexibility: No cracking.
- k. Crack Bridging Capability: No cracking, splitting, or loss of adhesion.
- l. Heat Stability: Comply with requirements for penetration, flow, low-temperature flexibility, and viscosity when heated for five hours at manufacturer's recommended application temperature.
- m. Viscosity Test: 2 to 15 seconds.

## 2.2 FLASHING SHEET MATERIALS

- A. Elastomeric Flashing Sheet: 50-mil minimum, uncured sheet neoprene as follows:

1. Tensile Strength: 1400 psi minimum; ASTM D 412, Die C.
2. Elongation: 300 percent minimum; ASTM D 412.
3. Tear Resistance: 125 psi minimum; ASTM D 624, Die C.
4. Brittleness: Does not break at minus 30 deg F; ASTM D 2137.

## 2.3 AUXILIARY MATERIALS

- A. Primer: ~~ASTM D 41, asphaltic primer.~~ As recommended as appropriate and compatible with roofing membrane system.
- B. Elastomeric Sheet: 50-mil- minimum, uncured sheet neoprene as follows:
1. Tensile Strength: 1400 psi minimum; ASTM D 412, Die C.
  2. Elongation: 300 percent minimum; ASTM D 412.
  3. Tear Resistance: 125 psi minimum; ASTM D 624, Die C.
  4. Brittleness: Does not break at minus 30 deg F; ASTM D 2137.
- C. Sealants and Accessories: Manufacturer's recommended sealants and accessories.
- D. Reinforcing Fabric: Manufacturer's recommended, spun-bonded polyester fabric.
- E. Protection Course: Manufacturer's standard, 80- to 90-mil- thick, fiberglass-reinforced rubberized asphalt or modified bituminous sheet.
- F. Roof Penetration Boots and Jacks: Provide those recommended by roofing system manufacturer, as appropriate and compatible with roofing membrane system.

## 2.4 INSULATION / INSULATED COMPOSITE PAVER BOARD

- A. Insulated Paver Board: Composite panel of 3/8" thick latex modified concrete permanently bonded to 2 inch thick polystyrene board insulation. Type VI, 40-psi minimum compressive strength. 24 x 48 inch board size, with T & G edges. R-10.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. "Light Guard" insulation panels by T-Clear.
    - b. Approved substitution
  2. Accessories: Provide manufacturer's recommended hold-down clips and straps. Provide stainless steel clips and straps.
- B. Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type VI, 40-psi minimum compressive strength; unfaced; fabricated with shiplapped or channel edges. R-10. Insulation to have integral drainage channels.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company (The); Styrofoam Roofmate.
    - b. Owens Corning; Foamular 404 .
    - c. Approved substitution.

## 2.5 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with waterproofing.
- B. Filter Fabric: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by waterproofing system manufacturer for application.

## 2.6 BALLAST

- A. Salvaged Aggregate Ballast:
1. Salvage existing aggregate ballast that meets minimum size requirements of new aggregate ballast.
  2. Clean salvaged ballast of organic material and debris prior to re-application.
- B. New Aggregate Ballast: Washed, smooth stone that will withstand weather exposure without significant deterioration and will not contribute to membrane degradation; of the following size:
1. Size: ASTM D 448, Size 4, ranging in size from 3/4 to 1-1/2 inches (19 to 38 mm).

## 2.7 DRAINAGE MAT

- A. High compressive strength drainage mat system. Polypropylene core to contain vertical cones that permit one-sided drainage. Triple spun bonded 100% polypropylene filter fabric is bonded to the top of the core.
1. Thickness: 0.4 inches, ASTM D 1777
  2. Compression (psf): 15,000, ASTM D 1621, compatible with system components.



3. Flow (gal/min/sf): 18, ASTM D 4716
4. Weight: (lbs/sq ft): 0.2

B. Accessories: manufacturer's recommend tape to join mat panels.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  1. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Clean and prepare substrates according to manufacturer's written instructions and ASTM D 4258. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
  1. If required by membrane manufacturer, abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove deleterious material to provide a sound surface free of asphalt, coal tar, laitance, glaze, efflorescence, curing compounds, and other non-acceptable materials. Remove remaining loose material and clean surfaces according to ASTM D 4258.
- E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

#### 3.3 JOINTS, CRACKS, AND TERMINATIONS

- A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.
  1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
  2. Adhere strip of elastomeric sheet to substrate in a layer of cold-applied membrane compound. Extend elastomeric sheet a minimum of 6 inches on each side of moving joints and cracks or joints and cracks exceeding 1/8 inch thick, and beyond deck drains and penetrations. Apply second layer cold-applied membrane compound over elastomeric sheet.

3. Embed strip of reinforcing fabric into a layer of cold-applied membrane. Extend reinforcing fabric a minimum of 6 inches on each side of nonmoving joints and cracks not exceeding 1/8 inch thick, and beyond roof drains and penetrations.
- B. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric sheet extended a minimum of 6 inches on each side of joints and adhere to substrates in a layer of cold applied membrane compound. Apply second layer of cold applied membrane compound over elastomeric sheet.

### 3.4 FLASHING INSTALLATION

- A. Install elastomeric flashing sheets at terminations of waterproofing membrane according to manufacturer's written instructions.
- B. Prime substrate with primer as recommended by manufacturer and as appropriate and compatible with membrane system.
- C. Install elastomeric flashing sheet and adhere to deck and wall substrates in a layer of cold applied membrane compound.
- D. Extend elastomeric flashing sheet up walls and parapets as indicated on Drawings. Continue flashing over the top of parapets, and 6 inches onto deck to be waterproofed.

### 3.5 MEMBRANE APPLICATION

- A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow to dry.
- B. Heat and apply rubberized asphalt according to manufacturer's written instructions.
  1. Heat rubberized asphalt in an oil- or air-jacketed melter with mechanical agitator specifically designed for heating rubberized asphalt.
- C. Start application with manufacturer's authorized representative present.
- D. Reinforced Membrane: Apply cold applied membrane compound to substrates and adjoining surfaces indicated. Spread to a thickness of 90 mils; embed reinforcing fabric, overlapping sheets 2 inches; spread another 125-mil- thick layer to provide a uniform, reinforced, seamless membrane 215 mils thick.
- E. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.
- F. Cure membrane per membrane manufacturer's instructions.
- G. Cover waterproofing with protection course with joints overlapped a minimum of 2 inches before membrane is subject to construction traffic.

### 3.6 DRAINAGE MAT INSTALLATION

- A. Install drainage mat per manufacturer's written instructions; Install with drain holes down so mat does not collect water.

## 3.7 INSULATION INSTALLATION

- A. Install one layer of insulation drainage panels over waterproofed surfaces and, when overall insulation thickness is 2 inches or more, install one or more additional layers of board insulation to achieve required thickness. Cut and fit to within 3/4 inch of projections and penetrations.
- B. Loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- C. Install insulation with joints of each succeeding layer staggered over joints of previous layer a minimum of 6 inches in each direction.

## 3.8 BALLAST INSTALLATION

- A. Install filter fabric over insulation, overlapping edges and ends at least 12 inches. Do not lap ends of fabric sheets within 72 inches of roof perimeter. Extend fabric 2 to 3 inches above ballast at perimeter and penetrations. Apply additional layer of fabric around penetrations to prevent aggregate from getting between penetration and insulation. Do not cover drains or restrict water flow to drains.
- B. To areas indicated, apply salvaged and new aggregate ballast uniformly over filter fabric at rate required by insulation manufacturer, but not less than the following, carefully spreading aggregate to not damage roofing membrane and base flashings. Apply ballast as insulation is installed, leaving roofing membrane insulated and ballasted at end of workday.
  - 1. Ballast: 12 lb/sq. ft., Size 4 aggregate.

## 3.9 PAVER BOARD INSTALLATION

- A. Install insulation paver board panels over roof areas indicated. Install in accordance with manufacturer's written instructions.
- B. Provide strapping per requirements for applicable installation zone.

## 3.10 FIELD QUALITY CONTROL

- A. Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation; and application of the membrane, flashings, protection, and drainage components and to conduct field adhesion testing; furnish daily reports to Architect.
- B. Flood Testing: Flood test each roof area for leaks, according to recommendations in ASTM D 5957, after completing and protecting waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
  - 1. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of sheet flashings.
  - 2. Flood each area for 48 hours.
  - 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
- C. Owner will engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.

3.11 CLEANING AND PROTECTION

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Protect installed board insulation and insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075556

## SECTION 076200 - SHEET METAL FLASHING AND TRIM

## 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. Formed low-slope roof sheet metal fabrications.
  - 2. Formed equipment support flashing.
- B. Related Sections:
  - 1. Section 061035 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
  - 2. Section 075556 "Cold Fluid-Applied Protected Membrane Roofing"
  - 3. Section 071413 "Hot Fluid Applied Protected Membrane Roofing"
  - 4. Section 086300 "Metal Framed Skylights" for installing sheet metal flashing and trim integral with skylights.

## 1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
  - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
  - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
  - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  - 4. Details of termination points and assemblies, including fixed points.

5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
  6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
  7. Details of special conditions.
  8. Details of connections to adjoining work.
  9. Detail formed flashing and trim at a scale of not less than 3 inches per 12 .
- C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
- E. Qualification Data: For qualified fabricator.
- F. Warranty: Sample of special warranty.
- G. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance. Fabricator to be approved by roofing or waterproofing manufacturer.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
  2. Review methods and procedures related to sheet metal flashing and trim.
  3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
  4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
  5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
- E. Metal Finishes: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

## 1.7 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leak-proof, secure and non-corrosive installation.

## 1.8 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period. System warranty including sheet metal flashing and trim to be provided by roofing manufacturer in Section 075556 "Cold Fluid-Applied Protected Membrane Roofing."
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.
  - 1. Finish: 2D (dull, cold rolled) .
  - 2. Surface: Smooth, flat.
- C. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
  - 2. Surface: Smooth, flat .
  - 3. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 4. Color: As selected by Architect from manufacturer's full range.

5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

D. Lead Sheet: ASTM B 749, Type L51121, copper-bearing lead sheet.

## 2.2 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

B. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.
3. Products: Subject to compliance with requirements, provide one of the following:
  - a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
  - b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
  - c. Henry Company; Blueskin PE200 HT.
  - d. Approved substitution.

C. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

## 2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturers of primary sheet metal and hot fluid-applied rubberized asphalt waterproofing unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
  - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
  - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel.

C. Solder:

1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
3. For Lead: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.



- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

#### 2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
  - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  - 2. Obtain field measurements for accurate fit before shop fabrication.
  - 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
  - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- H. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

#### 2.5 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
  - 1. Gutter Style: As indicated on Drawings.
  - 2. Expansion Joints: Butt type with cover plate.

3. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
  - a. Galvanized Steel: 0.022 inch thick.
4. Gutters with Girth 16 to 20 Inches: Fabricate from the following materials:
  - a. Galvanized Steel: 0.028 inch thick.
  
- B. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
  1. Fabricate from the following materials:
    - a. Galvanized Steel: 0.022 inch thick.
  
- C. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Provide lead soldered lead flanges as indicated on Drawings. Fabricate from the following materials:
  1. Stainless Steel: 0.019 inch thick.
  2. Flange: 0.0625 inch thick lead sheet (4 lb./ sq. ft.).
  
- D. Splash Pans: Fabricate from the following materials:
  1. Stainless Steel: 0.019 inch thick.
  2. Perforated as shown on drawings.

## 2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof-Edge Flashing: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections. Furnish with 6-inch- wide, joint cover plates.
  1. Joint Style: Butt, with 12-inch- wide, concealed backup plate.
  2. Fabricate from the following materials:
    - a. Galvanized Steel: 0.028 inch thick.
  
- B. Copings: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, seal, and solder or weld watertight.
  1. Joint Style: Standing seam.
  2. Fabricate from the following materials:
    - a. Galvanized Steel: 0.040 inch thick.
  
- C. Parapet Wall Covering:
  1. Joint Style: Standing seam.
  2. Fabricate from the following materials:
    - a. Galvanized Steel: 0.028 inch
  
- D. Base Flashing: Fabricate from the following materials:
  1. Galvanized Steel: 0.028 inch thick.
  
- E. Counterflashing: Fabricate from the following materials:
  1. Galvanized Steel: 0.022 inch thick.
  
- F. Flashing Receivers: Fabricate from the following materials:
  1. Galvanized Steel: 0.022 inch thick.
  
- G. Metal Sleeve and Storm Collars:
  1. Fabricate sleeves to extend 8 inches minimum up from roof deck. Solder all joints. Double solder vertical joints. Neutralize flux after soldering.
  2. Provide 4 inch lead flange soldered to stainless steel sleeve, completely around periphery.
  3. Form storm collar to shed water. Fabricate for compression attachment to pipe.

4. Materials:
  - a. Flange: 0.0625 inch thick lead sheet (4 lb./sq. ft.).
  - b. Sleeve and Collar: 0.0188 inch thick stainless steel.

H. Pitch Pans:

1. Fabricate as two piece box, sides to extend minimum 8 inches up from roof deck. Solder all joints. Double solder vertical joints. Neutralize flux after soldering.
2. Provide 4 inch lead flange soldered to bottom edge of box, completely around periphery.
3. Provide stainless steel cover to tightly cap box. Install on-site after aggregate ballast is applied.
4. Materials:
  - a. Flange: 0.0625 inch thick lead sheet (4 lb./sq. ft.).
  - b. Box and Cover: 0.0188 inch thick stainless steel.

I. Piping Box Covers:

1. Fabricate as two piece boxes, sides to extend 8 inches minimum up from roof deck. Solder all joints. Double solder vertical joints. Neutralize flux after soldering.
2. Provide 4 inch lead flange soldered to bottom edge of boxes, completely around periphery.
3. Materials:
  - a. Flange: 0.0625 inch thick lead sheet (4 lb./sq. ft.).
  - b. Box and Cover: 0.0188 inch thick stainless steel.

J. Vent Pipe Collars: Fabricate collars specifically for pipe diameters and lengths to be flashed. Fabricate collars to extend minimum of 1 inch beyond top of pipe.

1. Lead Sheet: 0.0625 inch thick (4 lb./sq. ft.).
2. Or as approved by roofing manufacturer for membrane system.

K. Roof-Drain Flashing: Fabricate from the following materials:

1. Lead Sheet: .0625 inch thick (4 lb./sq. ft.).
2. Or as approved by roofing manufacturer for membrane system.

## 2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

B. Miscellaneous Wall Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
  1. Verify compliance with requirements for installation tolerances of substrates.
  2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 UNDERLAYMENT INSTALLATION

- A. General: Install underlayment as indicated on Drawings.
- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

### 3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  - 3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
  - 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
  - 5. Install sealant tape where indicated.
  - 6. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
  - 1. Coat back side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
  - 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood framing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Seal joints as shown and as required for watertight construction.
  - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
  - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
  - 1. Do not solder prefinished metallic-coated steel sheet.
  - 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
  - 3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

### 3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
  - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.
  - 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of interlocking folded seam and sealant with anchor and washer at 36-inch centers.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.
- E. Vent Pipe Collars: Install close fitting lead flashing collar sized for vent pipe. Turn lead flashing down inside pipe to minimize obstruction of air flow.

### 3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

### 3.6 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

## 3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

## 3.8 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

## SECTION 086300 - METAL-FRAMED SKYLIGHTS

## 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 skylights with metal framing.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal-framed skylights.
- B. Shop Drawings: For metal-framed skylights. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
  - 2. Include full-size isometric details of each vertical-to-horizontal intersection of assembly, showing the following:
    - a. Joinery including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
    - e. Flashing and drainage.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Fabrication Sample: Of each framing intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
  - 1. Joinery including concealed welds.
  - 2. Anchorage.
  - 3. Expansion provisions.
  - 4. Glazing.
  - 5. Flashing and drainage.
- E. Delegated-Design Submittal: For metal-framed skylights indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Provide testing and approvals as required by authorities having jurisdiction.
- F. Agency Approval: Where specific testing and approvals are required by authorities having jurisdiction, submit all

- G. Qualification Data: For qualified Installer.
- H. Welding certificates.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for metal-framed skylights.
- J. Warranties: Sample of special warranties.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of metal-framed skylights required for this Project.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for skylights' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including testing conducted by an independent testing agency and in-service performance.
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- D. Provide metal-framed skylights that comply with test-performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard assemblies by a qualified independent testing agency.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical metal-framed skylights as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal-framed skylights that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Noise or vibration caused by thermal movements.



- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - d. Adhesive or cohesive sealant failures.
  - e. Water leakage.
2. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
- 1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
  - 2. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
- B. Basis-of-Design Product: Subject to compliance with requirements, provide one of the following:
- 1. Kawneer North America; an Alcoa company.
  - 2. Major Industries, Inc.; Auburn Skylights Division.
  - 3. DeaMor Skylights.
  - 4. Approved substitutions.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General: Metal-framed skylights shall withstand the effects of the following without failure due to defective manufacture, fabrication, installation, or other defects in construction:
- 1. Structural loads.
  - 2. Thermal movements.
  - 3. Movements of supporting structure.
  - 4. Dimensional tolerances of support system and other adjacent construction.
  - 5. Failure includes, but is not limited to, the following:
    - a. Deflection exceeding specified limits.
    - b. Thermal stresses transferring to building structure.
    - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
    - d. Noise or vibration created by wind and by thermal and structural movements.
    - e. Loosening or weakening of fasteners, attachments, and other components.
    - f. Sealant failure.
- B. Delegated Design: Design metal-framed skylights, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Smoke Control: Design new metal skylights to provide smoke control equal to existing system being replaced.
- D. Structural Loads:

1. Wind Loads: As indicated on Drawings.
  2. Seismic Loads: As indicated on Drawings.
- E. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Glazing Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding  $L/175$  of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to  $3/4$  inch, whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than  $1/8$  inch.
- F. Lateral Bracing of Framing Members: Compression flanges of flexural members are laterally braced by cross members with minimum depth equal to 50 percent of flexural member that is braced. Glazing does not provide lateral support.
- G. Structural-Test Performance: Provide metal-framed skylights tested according to ASTM E 330, as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- H. Air Infiltration: Provide metal-framed skylights with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..
- I. Water Penetration under Static Pressure: Provide metal-framed skylights that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft.
- J. Thermal Movements: Provide metal-framed skylights that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- K. Energy Performance: Provide metal-framed skylights with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have **U-factor of not more than 0.38 Btu/sq. ft. x h x deg F** as determined according to NFRC 100.
  2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a **solar heat gain coefficient of no greater than 0.39** as determined according to NFRC 200.
- 2.3 FRAMING SYSTEMS
- A. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
  2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
  3. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
  4. Structural Profiles: ASTM B 308/B 308M.
  5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
1. Include snap-on aluminum trim that conceals fasteners.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.
- D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. At pressure caps, use ASTM A 193/A 193M stainless-steel screws.
  2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  3. Reinforce members as required to receive fastener threads.
  4. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- E. Concealed Flashing: Dead-soft, 0.018-inch- thick stainless steel, ASTM A 240/A 240M of type recommended in writing by manufacturer.
- F. Exposed Flashing and Closures: Manufacturer's standard aluminum components not less than 0.040 inch thick.
- G. Framing Gaskets: Manufacturer's standard.
- H. Framing Sealants: As recommended in writing by manufacturer.
- I. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.4 GLAZING

- A. Glazing: As specified in Section 088000 "Glazing."
- B. Spacers, Setting Blocks, and Gaskets: Manufacturer's standard elastomeric types.
- C. Glazing Sealants: As recommended in writing by manufacturer.
1. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other components with which it comes in contact; and recommended in writing by structural- and weatherseal-sealant and metal-framed skylight manufacturers for this use.
    - a. VOC Content: 250 g/L or less.
    - b. Color: Matching structural sealant.

## 2.5 FABRICATION

- A. Where practical, fit and assemble metal-framed skylights in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Fabricate aluminum components before finishing.
- C. Fabricate aluminum components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within skylight to exterior.
  - 4. Physical and thermal isolation of glazing from framing members.
  - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
- D. Fabricate aluminum sill closures with weep holes and for installation as continuous component.
- E. Reinforce aluminum components as required to receive fastener threads.
- F. Weld aluminum components in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

## 2.6 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure nonmovement joints.

5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
  6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
  7. Seal joints watertight unless otherwise indicated.
- B. Metal Protection: Where aluminum will contact dissimilar materials, protect against galvanic action by painting contact surfaces with protective coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.
- C. Install continuous aluminum sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.
- D. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within skylight to exterior.
- E. Install components plumb and true in alignment with established lines and elevations.
- F. Install glazing as specified in Section 088000 "Glazing"
1. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to weatherseal-sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind weatherseal sealant as recommended in writing by weatherseal-sealant manufacturer.
- G. Erection Tolerances: Install metal-framed skylights to comply with the following maximum tolerances:
1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
  2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet but no greater than 1/2 inch over total length.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
1. Water-Spray Test: Before installation of interior finishes has begun, skylights shall be tested according to AAMA 501.2 and shall not evidence water penetration.
- B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

END OF SECTION 086300

## SECTION 088000 - GLAZING

## 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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  - 1. Skylights.

## 1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

## 1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
  - 1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
    - a. Wind Design Data: As indicated on Drawings.
  - 2. Design Snow Loads: As indicated on Drawings.
  - 3. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads:
    - a. Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.
    - b. Inward design wind pressure plus the weight of the glass plus half of the design snow load. Base design on glass type factors for short-duration load.
    - c. Half of the inward design wind pressure plus the weight of the glass plus the design snow load. Base design on glass type factors for long-duration load.

4. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
  5. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

#### 1.5 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: Insulating glass; 12 inches square.
- C. Glazing Accessory Samples: For gaskets, in 12-inch lengths.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location.
- E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Provide testing and approvals as required by authorities having jurisdiction.
- F. Qualification Data: For installers manufacturers of insulating-glass units with sputter-coated, low-e coatings and glass testing agency .
- G. Product Certificates: For glass and glazing products, from manufacturer.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass, insulating glass and glazing gaskets.
- I. Warranties: Sample of special warranties.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Source Limitations for Glass: Obtain insulating glass from single source from single manufacturer for each glass type.
- E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
  2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
  3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
  4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- G. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- I. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Install glazing in mockups specified in Section 086300 Metal-Framed Skylights to match glazing systems required for Project, including glazing methods.
  2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- J. Preinstallation Conference: Conduct conference at Project site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  2. Review temporary protection requirements for glazing during and after installation.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.



## 1.9 WARRANTY

- A. **Manufacturer's Special Warranty on Insulating Glass:** Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
1. **Warranty Period:** 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GLASS PRODUCTS, GENERAL

- A. **Thickness:** Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
1. **Minimum Glass Thickness for Exterior Lites:** Not less than 6.0 mm.
- B. **Strength:** Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. **Thermal and Optical Performance Properties:** Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For laminated-glass lites, properties are based on products of construction indicated.
  2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  3. **U-Factors:** Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  4. **Solar Heat-Gain Coefficient and Visible Transmittance:** Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  5. **Visible Reflectance:** Center-of-glazing values, according to NFRC 300.

### 2.2 GLASS PRODUCTS

- A. **Float Glass:** ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. **Heat-Treated Float Glass:** ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
1. **Fabrication Process:** By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
  2. For uncoated glass, comply with requirements for Condition A.
  3. For coated vision glass, comply with requirements for Condition C (other coated glass).

### 2.3 LAMINATED GLASS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cardinal Glass Industries.
  - 2. Approved substitution.
- B. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  - 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
  - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  - 3. Interlayer Color: Clear unless otherwise indicated.
- C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

### 2.4 INSULATING GLASS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cardinal Glass Industries.
  - 2. Approved substitution.
- B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
  - 1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary.
  - 2. Spacer: Stainless steel.
  - 3. Desiccant: Molecular sieve or silica gel, or blend of both.
- C. Glass: Comply with applicable requirements in "Glass Products" Article and in "Laminated Glass" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.

### 2.5 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from the following:
  - 1. EPDM complying with ASTM C 864.

### 2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

## 2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

## 2.8 INSULATING-LAMINATED-GLASS TYPES

- A. Glass Type: Low-e-coated, clear insulating laminated glass.
  - 1. Overall Unit Thickness: 1 inch.
  - 2. Thickness of Outdoor Lite: As required for glass performance indicated; not less than 4.0 mm.
  - 3. Outdoor Lite: Heat-strengthened float glass .
  - 4. Interspace Content: Argon as required for fenestration performance indicated.
  - 5. Indoor Lite: Clear laminated glass with two plies of heat-strengthened float glass.
    - a. Thickness of Each Glass Ply: As required for glass performance indicated; not less than 4.0 mm.
    - b. Interlayer Thickness: 0.030 inch.
  - 6. Low-E Coating: Sputtered on second surface.
  - 7. Visible Light Transmittance: 48 percent minimum.
  - 8. U-Factor: Maximum as required for fenestration performance indicated.
  - 9. Solar Heat Gain Coefficient: Maximum as required for fenestration performance indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

### 3.4 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying

pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- C. Install gaskets so they protrude past face of glazing stops.

### 3.5 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

## SECTION 09 90 00 PAINTING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
  - 1. Steel framing and supports for parapet bracing.
  - 2. Metal ramps with pipe and tube railings.
  - 3. Miscellaneous exterior metal surfaces.
  - 4. Interior plaster/gypsum at skylights.
  - 5. Existing skylight frames.

## 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: Provide minimum of three draw-downs.
  - 1. Submit Samples on rigid backing, 8 inches square.
- D. Results of adhesion testing.

## 1.4 QUALITY ASSURANCE

- A. MPI Standards:
  - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
  - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
- B. Adhesion Testing: Conduct on-site test of primer and top coat over existing, prepared metal substrate.
  - 1. Owner will select one surface to represent surfaces and conditions for application.
  - 2. Apply primer to 2 x 2 ft. area. Allow to fully dry and cure. Test adhesion by scratch and pull methods.
  - 3. Apply primer and finish coat to 2 x 2 ft. area. Allow each coat to fully dry. Test adhesion by scratch and pull methods.
  - 4. Prepare report of results and verify that coatings will receive warranty.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

## 1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

## 1.7 WARRANTY

- A. Provide manufacturer's warranty for both prime and finish coats. Warrant against failure of adhesion, both of system to metal and masonry substrate and finish coat to prime coat.
  - 1. Warranty Period: 10 years.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ~~Sto Corp.~~
  - 2. PPG Industries, INC.
  - 3. Miller Paint Co.
  - 4. Benjamin Moore and Co.
  - 5. Rodda Paint Co.
  - 6. Sherwin Williams Co.
  - 7. Approved substitutions.

## 2.2 PAINT, GENERAL

- A. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range.

## 2.3 COATINGS

- A. Metal:

1. Exterior Metal Primer for acrylic urethane: Factory-formulated polyamide-epoxy two component primer for exterior applications.
  - a. VOC: 150 voc g/liter or less
  - b. PPG Industries; PITT-GUARD Rapid Coat Direst-To-Rust Epoxy, 95-245 Series: Apply one coat at a dry film thickness between 4.7 and 8.2 mils.
2. Exterior Metal Finish Coats: Factory-formulated acrylic aliphatic urethane for exterior applications.
  - a. VOC: 200 voc g/liter or less
  - b. PPG Industries; PITT-TECH DTM, 100% acrylic formula. Apply two coats at a wet film thickness between 5.5 to 8.3 mils each. Allow first coat to dry before applying second coat.

B. Plaster / Gypsum

1. Low VOC acrylic latex primer – 1 coat
2. Low VOC acrylic latex finish – 2 coats – sheen to match existing.

2.4 ACCESSORY MATERIALS

- A. Surface Cleaner: As recommended by paint manufacturer for substrates to be painted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for conditions affecting performance of work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Patching: remove loose material and patch and fill with compatible materials to form continuous surface
- C. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
  2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- D. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.



1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- E. Galvanized-Metal Substrates: Remove rust, dirt, residue from galvanized sheet metal by pre-treatment and mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
1. Use applicators and techniques suited for paint and substrate indicated.
  2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
  2. Testing agency will perform tests for compliance of paint materials with product requirements.
  3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 09 90 00

## SECTION 230000 - BASIC HVAC REQUIREMENTS

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Work included in 23 00 00 applies to Division 23 work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of heating, ventilating and air conditioning systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
  - 1. Provide: To furnish and install, complete and ready for intended use.
  - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
  - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work provided.
  - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01 requirements, and approved by the Engineer prior to submitting bids for substituted items.
  - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's representative, and other reviewing entity whose approval is required to obtain systems acceptance.

## 1.2 RELATED SECTIONS:

- A. Contents of Section applies to Division 23 Contract Documents.
- B. Related Work:
  - 1. Additional conditions apply to this Division including, but not limited to:
    - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
    - b. Drawings
    - c. Addenda
    - d. Owner/Architect Agreement
    - e. Owner/Contractor Agreement
    - f. Codes, Standards, Public Ordinances and Permits

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards per Division 01, General Requirements, individual Division 23 Sections and those listed in this section.

- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
1. State of Oregon:
    - a. OAR Oregon Administrative Rules
    - b. OESC Oregon Electrical Specialty Code
    - c. OFC Oregon Fire Code
    - d. OMSC Oregon Mechanical Specialty Code
    - e. OPSC Oregon Plumbing Specialty Code
    - f. OSSC Oregon Structural Specialty Code
    - g. OEESC Oregon Energy Efficiency Specialty Code
    - h. Oregon Elevator Specialty Code
- C. General: Reference standards and guidelines include but are not limited to the latest adopted editions from:
1. ADA Americans with Disabilities Act
  2. AHRI Air-Conditioning Heating & Refrigeration Institute
  3. AMCA Air Movement and Control Association
  4. ANSI American National Standards Institute
  5. ASCE American Society of Civil Engineers
  6. ASHRAE American Society of Heating, Refrigeration and Air-Conditioning Engineers
  7. ASHRAE Guideline, The Commissioning Process
  8. ASCE American Society of Civil Engineers
  9. ASME American Society of Mechanical Engineers
  10. ASPE American Society of Plumbing Engineers
  11. ASSE American Society of Sanitary Engineering
  12. ASTM ASTM International
  13. AWWA American Water Works Association
  14. CFR Code of Federal Regulations
  15. CGA Canadian Gas Association
  16. CHPS Collaborative for High Performance Schools
  17. CISPI Cast Iron Soil Pipe Institute
  18. CSA CSA International
  19. EPA Environmental Protection Agency
  20. ETL Electrical Testing Laboratories
  21. FDA Food and Drug Administration
  22. FM FM Global
  23. GAMA Gas Appliance Manufacturers Association
  24. HI Hydraulic Institute Standards
  25. IAPMO International Association of Plumbing & Mechanical Officials
  26. ISO International Organization for Standardization
  27. LEED Leadership in Energy and Environmental Design
  28. MSS Manufacturers Standardization Society
  29. NEC National Electric Code
  30. NEMA National Electrical Manufacturers Association
  31. NFPA National Fire Protection Association
  32. NFGC National Fuel Gas Code
  33. NRCA National Roofing Contractors Association
  34. NSF National Sanitation Foundation

35. OSHA Occupational Safety and Health Administration
36. SMACNA Sheet Metal and Air Conditioning Contractors' National Association, Inc.
37. TEMA Tubular Exchanger Manufacturers Association
38. TIMA Thermal Insulation Manufacturers Association
39. UL Underwriters Laboratories, Inc.
40. USDA United States Department of Agriculture

- D. See Division 23 individual sections for additional references.
- E. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- F. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- G. Piping Insulation products to contain less than 0.1% by weight PBDE in all insulating materials across the board.

#### 1.4 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 23 sections.
- B. Provide product submittals and shop drawings in electronic format. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one zip file per specification division containing a separate file for each specification section. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.
- C. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 23 sections.
- D. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
  1. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
  2. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Refer to individual Division 23 Specification sections for specific items required in product data submittal outside of these requirements.
  3. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
  4. For vibration isolation of equipment, list make and model selected with operating load and deflection.
  5. See Division 23 individual sections for additional submittal requirements.

- E. Maximum of two reviews of submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
- F. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet Section 230548. Provide engineered seismic drawings and equipment seismic certification. Building Occupancy Category III. Seismic Design Category D. Equipment Importance Factor of 1.0
- G. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required by Division 23 Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26 submittals.
- H. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
- I. Substitutions and Variation from Basis-of-Design:
  - 1. Basis-of-Design systems, components and controls for equipment are selected and sized based on the equipment specified as the first-named, model number and supplemental additional options as indicated in the Contract Documents. If substitutions and/or equivalent equipment/products proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
- J. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, equipment, ductwork and piping layout plans, and control wiring diagrams. Refer to individual Division 23 Specification sections for additional requirements for shop drawings outside of these requirements.
  - 1. Provide Shop Drawings indicating access panel locations for items that require Code or maintenance access, size and elevation for approval prior to installation.
- K. Samples: Provide samples when requested by individual sections.
- L. Resubmission Requirements:
  - 1. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
    - a. Resubmit for review until review indicates no exceptions taken or make "corrections as noted".
    - b. When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.

M. Operation and Maintenance Manuals, Owners Instructions:

1. Submit, at one time, electronic files (PDF format) on CD/DVD of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
  - a. Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
  - b. Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
  - c. Include Warranty per Division 00 and Division 01, Section 23 00 00 and individual sections.
  - d. Include product certificates of warranties and guarantees.
  - e. Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
  - f. Include copy of startup and test reports specific to each piece of equipment.
  - g. Include copy of final air and water systems balancing log along with pump, fan and distribution system operating data.
  - h. Include commissioning reports.
  - i. Include copy of valve charts/schedules.
  - j. Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
2. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 23 00 00 Article titled "Demonstration".
3. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

N. Record Drawings:

1. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
2. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
3. At completion of project, input changes to original project CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.
4. Bottom of pipe, duct and equipment elevations and dimensioned locations for all distribution systems (hydronic and air). Invert elevations and dimensioned locations for underground systems below grade to 5-feet outside building.
5. See Division 23 individual sections for additional items to include in record drawings.

## 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State, Federal and other applicable laws and regulations.
- B. Drawings are intended to be diagrammatic and reflect the Basis-of-Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis-of-Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- E. UL and CSA Compliance: Provide products which are UL and CSA listed.

## 1.6 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 01, Section 23 00 00 and individual Division 23 sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01 and the General Conditions. Confirm requirements in all Contract Documents.

## 1.7 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, equipment, fire sprinklers, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- C. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Provide like items from one manufacturer, including but not limited to pumps, fans, valves, control devices, air handlers, vibration isolation devices, etc.

## 2.2 MATERIALS

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL approved or have adequate approval or be acceptable by State, County, and City authorities.
- B. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.
- C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- D. Do not use any materials containing a hazardous substance as defined by EPA, including but not limited to arsenic, lead, asbestos, or volatile organic compound (VOC).

## PART 3 - EXECUTION

## 3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00 and Division 01, Section 23 00 00 and individual Division 23 sections.
- B. Install equipment having components requiring access (i.e., drain pans, drains, control operators, valves, motors and vibration isolation devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.
- D. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 23 sections and the following:
  - 1. Earthwork:
    - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
    - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.



- c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Confirm Firestopping requirements in Division 07. In absence of specific requirements, comply with individual Division 23 sections and the following:
- 1. Firestopping:
    - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Pipe Installation:
- 1. Coordinate work to account for expansion and contraction of piping materials and building, as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
  - 2. Include provisions for servicing and removal of equipment without dismantling piping.
- G. Plenums:
- 1. In plenums, provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

### 3.2 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, Section 23 00 00 and individual Division 23 sections.
- B. General:
- 1. Seismic Design Category: D Soils.
  - 2. Building Category: III.
  - 3. Importance Factor (I-p): Equipment importance factor of 1.0.
  - 4. Earthquake resistant designs for HVAC (Division 23) equipment and distribution, i.e. motors, ductwork, piping, equipment, etc. conform to regulations of jurisdiction having authority.
  - 5. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
  - 6. Provide stamped shop drawings from licensed structural engineer of seismic bracing and seismic movement assemblies for piping, ductwork, equipment, and system appurtenances. Submit shop drawings along with equipment submittals.
  - 7. Provide stamped shop drawings from licensed Structural Engineer of seismic flexible joints for system crossing building expansion or seismic joints. Submit shop drawings along with seismic bracing details. Coordinate exact design requirements with project Structural Engineer.
- C. Piping and Ductwork:
- 1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.

- D. Equipment:
  - 1. Provide means to prohibit excessive motion of equipment during earthquake.

### 3.3 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Division 01, Section 23 00 00 and individual Division 23 Sections.
- B. Notify Architect, in writing, at following stages of construction so that Architect may, at their option, visit site for review and construction observation:
  - 1. Underground system installation prior to backfilling.
  - 2. Prior to covering walls.
  - 3. Prior to ceiling cover/installation.
  - 4. After major equipment is installed.
  - 5. When main systems, or portions of, are being tested and ready for inspection by AHJ.
  - 6. Final Punch:
    - a. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

### 3.4 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00 and Division 01. In absence of specific requirements, comply with individual Division 23 sections and the following:
  - 1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
  - 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping and ductwork, and wiring to point of connection. Where existing systems are being utilized, clean existing distribution systems (ductwork, piping, fans, air handlers) prior to connecting new ductwork or piping.
  - 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
    - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
  - 4. Organize work to minimize duration of power interruption.

### 3.5 CUTTING AND PATCHING

- A. Confirm Cutting and Patching requirements in Division 00 and Division 01. In absence of specific requirements, comply with individual Division 23 sections and the following:
  - 1. Proposed floor cutting/core drilling/sleeve locations to be approved by project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
  - 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section and will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
  - 3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.

4. Restore new or existing work that is cut and/or damaged to original condition. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

### 3.6 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

### 3.7 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00 and Division 01. In absence of specific requirements, comply with individual Division 23 sections and the following:
  1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage to be replaced before installation.
  2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
  3. Protect bright finished shafts, bearing housings and similar items until in service.

### 3.8 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00 and Division 01, Section 23 00 00 and individual Division 23 Sections.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, Section 23 00 00 and individual Division 23 sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

### 3.9 CLEANING

- A. Confirm Cleaning requirements in Division 01, Section 23 00 00 and individual Division 23 sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

### 3.10 INSTALLATION

- A. Confirm Installation requirements in Division 00, Division 01, Section 23 00 00 and individual Division 23 sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
  - 1. Do not place equipment in sustained operation prior to initial balancing of HVAC systems.
- D. Provide miscellaneous supports/metals required for installation of equipment, piping and ductwork.

### 3.11 DEMOLITION

- A. Confirm requirements in Division 01 and Division 02. In absence of specific requirements, comply with individual Division 23 sections and the following:
  - 1. Scope:
    - a. It is the intent of these documents to provide necessary information and adjustments to the HVAC system required to meet code, and accommodate installation of new work.
    - b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
    - c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
  - 2. Equipment: Remove items not scheduled to be reused or relocated from job site as directed by Owner. Salvage existing direct digital controllers to Owner.
  - 3. Unless specifically indicated on Drawings, remove exposed, unused ductwork and piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap and patch surfaces to match surrounding finish.
  - 4. Unless specifically indicated on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).

### 3.12 ACCEPTANCE

- A. Confirm requirements in Division 00 and Division 01. In absence of specific requirements, comply with individual Division 23 sections and the following:
  - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
    - a. Testing and Balancing Reports
    - b. Cleaning
    - c. Operation and Maintenance Manuals
    - d. Training of Operating Personnel
    - e. Record Drawings
    - f. Warranty and Guaranty Certificates
    - g. Start-up/Test Document
    - h. Commissioning Reports

## 3.13 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 01, Section 23 00 00 and individual Division 23 sections.
- B. Tests:
  - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Refer to individual Specification sections for required tests. Document tests and include in Operation & Maintenance Manuals.
  - 2. During site evaluations by Architect or Engineer, provide an electrician with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

## 3.14 ELECTRICAL INTERLOCKS

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

END OF SECTION

## SECTION 230513 - MOTORS AND COMMON ELECTRICAL WORK FOR HVAC SYSTEMS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work Included: Provision of materials, installation and testing of:
  - 1. Low Voltage Control Wiring
  - 2. Disconnects

## 1.2 RELATED SECTIONS

- A. Contents of Division 23 and Division 01, General Requirements apply to this section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00 and Division 01, General Requirements.
  - 1. NEMA Premium Efficiency.
  - 2. Energy Policy Act (EPACT), latest applicable version(s) for minimum motor efficiencies.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00 and Division 01, General Requirements.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Field Installed Motors: Installed motors to be of single type, from one source and from a single manufacturer.

## 1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00 and Division 01, General Requirements.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Low Voltage Control Wiring:
  - 1. General Electric
  - 2. Anaconda
  - 3. Rome
  - 4. Or approved equivalent.

## 2.2 LOW VOLTAGE CONTROL WIRING

- A. General 60 Hz Control Circuiting: 600 volts insulated 14 gauge Type THHN, color coded, installed in conduit in mechanical rooms and exposed locations. Other areas plenum rated cable is allowed. Refer to Division 26 Specifications for details of wiring and conduit.

## 2.3 DISCONNECTS

- A. Provided by Division 26 unless specifically specified otherwise.

## PART 3 - EXECUTION

### 3.1 ELECTRICAL REQUIREMENTS

- A. Provide the following where applicable:
  - 1. Starters and disconnects if they are integral parts of mechanical equipment as shown on the equipment schedules. Refer to Drawings and subsequent Sections.
  - 2. Low voltage and electronic control devices.
  - 3. Low voltage transformers.
  - 4. Low voltage conduit and wire and connecting devices.
  - 5. Conduit and wire for electronic devices, except for line voltage wiring.
- B. Electrical work listed above performed by a licensed electrical contractor or by the control manufacturer, but provided for and coordinated under Division 23 work. In addition, controls work supervised and subsequently approved in writing by the control manufacturer.
- C. Furnish the following to the Electrical Contractor where applicable: Line voltage control equipment, including switches (except disconnects), time switches, transformers, relays, etc.
- D. Include the following items under Division 26 work:
  - 1. Line voltage wire and conduit system.
  - 2. Starters and disconnects not provided with equipment.
  - 3. Installation of line voltage control equipment furnished under Paragraph 3.01.C.above.

### 3.2 ELECTRICAL INTERLOCKS

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize mechanical equipment wiring diagrams to coordinate with the electrical systems so that proper wiring of the equipment involved is affected.

### 3.3 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
  - 2. Test interlocks and control features for proper operation.
  - 3. Verify that current in each phase is within nameplate rating.

- B. Testing: Perform the following field quality-control testing:
  - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. 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.
  
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
  - 1. Inspect field-assembled components, equipment installation, and piping and electrical connections for compliance with requirements.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Verify bearing lubrication.
  - 4. Verify proper motor rotation.
  - 5. Test Reports:
    - a. Prepare a written report to record the following test procedures used:
      - 1) Test results that comply with requirements.
      - 2) Test results that do not comply with requirements and corrective action taken to achieve compliance.

### 3.4 CONTROLLERS

- A. Install enclosed controllers in accordance with manufacturer's instructions.
- B. Coordinate disconnect requirements and location with Division 26 if not integral to controller. If controller is installed out of line of sight of motor, provide additional disconnect at motor per code.
- C. Provide NEMA housing appropriate to installation location.
- D. Provide supports and install securely, in neat and workmanlike manner, as specified in NECA 1.
- E. Meet mounting height and accessible location requirements per local code.
- F. Provide fuses for fusible switches.
- G. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- H. Provide engraved plastic nameplates.

### 3.5 ADJUSTING

- A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.



3.6 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

## SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work included: Provision of materials, installation and testing of:
  - 1. Seismic Restraint Devices
  - 2. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping, and Ductwork

## 1.2 RELATED SECTIONS

- A. Contents of Division 23 and Division 01, General Requirements apply to this Section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. OSHPD: Office of Statewide Health Planning and Development for the State of California. OSHPD assigns a unique anchorage preapproval "OPA" number to each seismic restraint it tests. The number describes a specific device applied as tested.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Seismic Restraint:
    - a. Shop Drawings: Show compliance with requirements of Quality Assurance article of this section. Shop drawings to be stamped by a professional structural engineer licensed in State of Oregon.
    - b. Calculations: Submit seismic calculations indicating restraint loadings resulting from design seismic forces. Include anchorage details and indicate quantity, diameter, and depth of penetration of anchors. Calculations certified by professional structural engineer licensed in State of Oregon.
  - 2. Seismic Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
  - 3. Welding certificates.
  - 4. Equipment Certification:
    - a. Provide seismic certification for equipment as noted in Seismic Design Summary schedule on plans.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00 and Division 01, General Requirements.

- B. In addition, meet the following:
1. Seismic Restraint:
    - a. Code and Standard Requirements:
      - 1) Seismic restraint of equipment, piping, and ductwork to be in accordance with latest enacted version of OSSC Chapter 16.
    - b. Seismic Design Category:
      - 1) Seismic design category for mechanical equipment and systems is same as general building structure, and is listed in project general structural notes.
      - 2) Seismic design category for mechanical equipment and systems to be Category D
    - c. Occupancy Category:
      - 1) Refer to Architectural plans and specifications for Building occupancy category for mechanical equipment and systems.
      - 2) Building occupancy category for mechanical equipment and system is Category III.
    - d. Importance Factors: See Seismic Design Summary table on plans for equipment importance factors.
    - e. Seismic restraint and anchorage of permanent equipment and associated systems listed below to building structure be designed to resist total design seismic force prescribed in local building code:
      - 1) Floor- or roof-mounted equipment weighing 400 pounds or greater.
      - 2) Suspended, wall-mounted or vibration isolated equipment weighing 20 pounds or greater.
      - 3) In-line duct devices connected to ductwork weighing 75 pounds or greater.
      - 4) Housekeeping slabs: provide reinforcement and anchorage to building structure.
    - f. Where required, seismic sway bracing of suspended duct and piping meet following:
      - 1) Pipe and duct runs requiring seismic bracing have minimum of two traverse braces and one longitudinal brace. Longitudinal (or traverse) brace at 90 degree change in direction may act as traverse (or longitudinal) brace if located within 2-feet of change in direction.
      - 2) Seismic bracing may not pass through seismic separation joint. Pipe or duct runs that pass through seismic separation joint must be restrained within 5-feet of both sides of separation.
      - 3) Seismic brace assembly spacing not to exceed 40-feet transverse and 80-feet longitudinal.
    - g. Seismic restraints may be omitted from suspended piping and duct if following conditions are satisfied:
      - 1) For piping or ducts supported by rod hangers 12-inches or less in length from top of duct to bottom of structural support. Top connections to structure have swivel joints, eye bolts, or vibration isolation hangers for entire length of system run.
      - 2) Lateral motion of system will not cause damaging impact with surrounding systems or cause loss of system vertical support.
      - 3) System must be welded steel pipe, brazed copper pipe, sheet metal duct or similar ductile material with ductile connections.
- C. Seismic restraints, including anchors to building structure, be designed by registered professional structural engineer licensed in State of Oregon. Design includes:
1. Number, size, capacity, and location of anchors for floor- or roof-mounted equipment. For curb-mounted equipment, provide design of attachment of both unit to curb and curb to structure.
  2. Number, size, capacity, and location of seismic restraint devices and anchors for vibration-isolation and suspended equipment. Provide calculations, test data, verifying horizontal and vertical ratings of seismic restraint devices.

3. Number, size, capacity, and location of braces and anchors for suspended piping and ductwork on as-built plan drawings.
4. Maximum seismic loads to be indicated on drawings at each brace location. Drawings bear stamp and signature of registered professional structural engineer who designed layout of braces.

#### 1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00 and Division 01, General Requirements.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Seismic Snubber Units: Furnish replacement neoprene inserts for snubbers.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Seismic Restraint Devices:
  1. Amber/Booth Company, Inc.
  2. B-Line Systems, Inc.
  3. Hilti, Inc.
  4. Kinetics Noise Control, Inc.
  5. Mason Industries, Inc.
  6. California Dynamics Corporation
  7. TOLCO Incorporated.
  8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
  9. M.W. Sausse - Vibrex
  10. Or approved equivalent.
- B. Seismic-Bracing/Restraint Devices/Systems for Equipment:
  1. Amber-Booth
  2. California Dynamics Corporation
  3. Cooper B-Line, Inc.
  4. Hilti, Inc.
  5. Mason Industries, Inc.
  6. Kinetics Noise Control.
  7. Unistrut
  8. ISAT, Inc.
  9. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
  10. Or approved equivalent.

#### 2.2 SEISMIC RESTRAINT DEVICES

- A. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.

- B. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings. Mason Type Z-1011, or Z1225.
  - 1. Anchor bolts for attaching to concrete be seismic-rated, drill-in, and stud-wedge or female-wedge type.
  - 2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.
- C. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement. Mason Type SCB.
- D. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

### 2.3 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT

- A. General Requirements for Restraint Components: Rated strengths, features, and applications be as defined in reports by agency acceptable to authorities having jurisdiction.
- B. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components be at least four times maximum seismic forces to which they will be subjected.
- C. Anchor bolts for attaching to concrete be seismic-rated, drill-in, and stud-wedge or female-wedge type.
- D. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
- E. Maximum 1/4-inch air gap, and minimum 1/4-inch thick resilient cushion.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General:
  - 1. Vibration isolators and seismic restraint systems must be installed in strict accordance with manufacturer's written instructions and certified submittal data.
  - 2. Do not install equipment or pipe which makes rigid contact with building slabs, beams, studs, walls, etc.
  - 3. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances is isolation efficiency to be destroyed when bolting isolators to floor.
  - 4. Provide roof curbs, equipment supports, and roof penetrations. Work to maintain roof warranty. Coordinate location, size, structural connections/requirements and flashing prior to installation.

5. Install type 6 horizontal thrust restraints at centerline of thrust, symmetrical on either side of equipment.
6. Vibration isolators must not cause change of position of equipment or piping which would stress piping connections or misalignment shafts or bearings. Isolated equipment is to be level and in proper alignment with connecting ducts and pipes.

### 3.3 SEISMIC RESTRAINTS

#### A. General:

1. Install and adjust seismic restraints so that equipment, piping, and ductwork supports are not degraded by restraints.
2. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise.
3. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
4. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.

### 3.4 CLEANING

- #### A.
- After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION

## SECTION 230553 - IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work included: Provision of materials, installation and testing of:
  - 1. Plastic Nameplates
  - 2. Lettering and Graphics

## 1.2 RELATED SECTIONS

- A. Contents of Division 23 and Division 01, General Requirements apply to this section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00 and Division 01, General Requirements.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00 and Division 01, General Requirements.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
  - 2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

## 1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00 and Division 01, General Requirements.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than a single type is specified for application, provide single selection for each product category.
- B. Manufacturers:
  - 1. Brady Corporation
  - 2. Seton Identification Products
  - 3. Craftmark
  - 4. Brimer
  - 5. Or approved equivalent.

## 2.2 PLASTIC NAMEPLATES

- A. Description: Engraving stock melamine plastic laminate, Federal Specification L-P-387, in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color), punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Provide 1/8-inch thick material.
  - 1. Letter Color: White.
  - 2. Letter Height: 1/2-inch.
  - 3. Background Color: Black.
  - 4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

## 2.3 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
- B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces for stencil painting.

### 3.2 INSTALLATION

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- B. Coordinate with the facility maintenance personnel to insure consistency with the existing tagging system.
- C. Identify air handling units with plastic nameplates riveted to equipment body.
- D. Identify control panels and major control components outside panels with plastic nameplates riveted to equipment body.
- E. Tag automatic controls, instruments, and relays. Key to control schematic.

END OF SECTION



## SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work Included: Provision of materials, installation and testing of:
  - 1. Taking pre-tests of existing systems as identified on drawings.
  - 2. Adjusting total HVAC systems to provide indicated quantities.
  - 3. Measuring electrical performance of HVAC equipment.
  - 4. Setting quantitative performance of HVAC equipment.
  - 5. Verifying that automatic control devices are functioning properly.
  - 6. Reporting results of the activities and procedures specified in this Section.

## 1.2 RELATED SECTIONS

- A. Contents of Division 23 and Division 01, General Requirements apply to this section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00 and Division 01, General Requirements.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Quality-Assurance Submittals: Submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
  - 2. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.
  - 3. Strategies and Procedures Plan: Submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 below. Include a complete set of report forms intended for use on this Project.
  - 4. Specify reports required because of editing procedures in Part 3 of this Section.
  - 5. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
  - 6. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.
  - 7. Test Instrument Calibration: Submit proof of calibration within the last 6 months.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00 and Division 01, General Requirements.

- B. In addition, meet the following:
1. Acceptable Balance Firm:
    - a. General:
      - 1) Procure services of independent balance and testing agency, approved by Architect, which specializes in balancing and testing of plumbing, heating, ventilating, and air conditioning systems, to balance, adjust and test water circulating and air moving equipment and air distribution or exhaust systems. Minimum Experience: 5 years.
    - b. Industry Standards: Testing and Balancing will conform to NEBB, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), and American National Standards Institute (ANSI) as follows:
      - 1) NEBB: Comply with Procedural Standards for Testing, Adjusting Balancing of Environmental Systems.
      - 2) ASHRAE: Comply with recommendations pertaining to measurements, instruments, and testing, adjusting and balancing.
      - 3) ANSI:
        - (a) S1.4 Specifications for sound level meters.
        - (b) S1.11 Specifications for Octave-Band and Fractional-Octave-Band analog and digital filters.
    - c. Test Observation: If requested, conduct tests in the presence of the Architect or the Architect's representative.
  2. Provide proof of testing agency having successfully completed at least five projects of similar size and scope.
  3. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).
  4. Owner Witness: Perform tests in the presence of the Owners representative.
  5. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.
  6. Simultaneous Testing: Test observations by the Authority Having Jurisdiction (AHJ), the Owner's representative and the engineer's representative need not occur simultaneously.
  7. Do not perform testing, adjusting, and balancing work until heating, ventilating, and air conditioning equipment has been completely installed and is operating continuously as required.
  8. Conduct air testing and balancing with clean filters in place. Clean strainers prior to performing hydronic testing and balancing.
  9. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by AABC or NEBB.
  10. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.
    - a. Agenda Items: Include at least the following:
      - 1) Submittal distribution requirements.
      - 2) Contract Documents examination report.
      - 3) Testing, adjusting, and balancing plan.
      - 4) Work schedule and Project site access requirements.
      - 5) Coordination and cooperation of trades and subcontractors.
      - 6) Coordination of documentation and communication flow.

11. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
  - a. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
  - b. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
12. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."
13. Testing, Adjusting, and Balancing Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
14. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.
15. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
16. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

#### 1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, provide:
  1. TAB Agency provides warranty for a period of 90 days following submission of completed report, during which time, Owner may request a recheck of up to 10 percent of total number of terminals, or resetting of any outlet, coil, or device listed in the final TAB report.
  2. Guarantee: Meet the requirements of the following programs:
    - a. Provide a guarantee on AABC or NEBB forms stating that the agency will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
      - 1) The certified Agent has tested and balanced systems according to the Contract Documents.
      - 2) Systems are balanced to optimum performance capabilities within design and installation limits.

#### 1.7 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a persons skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.

- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. TAB: Testing and Balancing.
- K. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- L. Test: A procedure to determine quantitative performance of a system or equipment.
- M. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- N. Retain acronyms and abbreviations that remain after this Section has been edited for Project.
- O. AABC: Associated Air Balance Council.
- P. AMCA: Air Movement and Control Association.
- Q. CTI: Cooling Tower Institute.
- R. NEBB: National Environmental Balancing Bureau.
- S. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

## 1.8 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

## PART 2 - PRODUCTS - NOT USED

## PART 3 - EXECUTION

### 3.1 PROJECT CONDITIONS

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.
- B. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

### 3.2 GENERAL REQUIREMENTS

- A. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and controls, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Perform TAB work with doors, closed windows, and ceilings installed etc., to obtain simulated or project operating conditions. Do not proceed until systems scheduled for testing, adjusting and balancing are clean and free from debris, dirt and discarded building materials.
- C. Where Owner occupies building during the testing period, cooperate with Owner to minimize conflicts with Owner's operations.

### 3.3 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
  - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
  - 2. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine project record documents described in Division 01.
- D. Examine Architect's and Engineer's design data, including Basis-of-Design, HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

- F. Coordinate requirements in system and equipment with this Section.
- G. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- H. Examine system and equipment test reports.
- I. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- J. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- K. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- L. Examine equipment for installation and for properly operating safety interlocks and controls.
- M. Examine automatic temperature system components to verify the following:
  - 1. Dampers operate by the intended controller.
  - 2. Dampers are in the position indicated by the controller.
  - 3. Integrity of dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
  - 4. Sequence of operation for control modes is according to the Contract Documents.
  - 5. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
  - 6. Interlocked systems are operating.
  - 7. Changeover from heating to cooling mode occurs according to design values.
- N. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.
- O. Beginning of work means acceptance of existing conditions.

### 3.4 PREPARATION

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
  - 1. Permanent electrical power wiring is complete.
  - 2. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Balance dampers are open.
  - 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 6. Windows, doors and other portions of the building envelope can be closed so design conditions for system operations can be met.

- C. Hold a pre-balancing meeting at least one week prior to starting TAB work.
  - 1. Attendance is required by installers whose work will be tested, adjusted, or balanced.
- D. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

### 3.5 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

### 3.6 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.

### 3.7 RECORDING AND ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. Mark on drawings locations where traverse and other critical measurements were taken and cross reference location in final report.
- D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

### 3.8 PRE-CONSTRUCTION BALANCE (EXISTING SYSTEMS)

- A. Pre-Construction Balance - Air Systems
  - 1. Prior to start of construction or demolition; read and record airflow to establish "as-found" conditions. Provide pitot traverse of supply, return and exhaust ductwork at locations indicated on drawings and, as minimum, at central air handlers, main branch ductwork and at each floor.
  - 2. Read and record static pressure conditions across existing filters, coils and fans.
  - 3. Read and record amp draw and motor data from each existing air handler and fan that will be modified during project.
- B. Report data and observations to Architect.

### 3.9 FUNDAMENTAL AIR SYSTEMS BALANCING PROCEDURES

- A. Prepare test reports for both fans and inlets and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with thermal protection, sized for the connected load.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check that condensate drains are installed, trapped and primed and routed to drain.
- J. Check for readily observable leaks in air-handling unit components and ductwork.

### 3.10 CONSTANT-VOLUME AIR SYSTEMS BALANCING PROCEDURES

- A. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer. Adjust fans to deliver design airflow at the lowest possible speed.
  - 1. Measure fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable 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 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.
2. Measure static pressure across each air-handling unit component under final balanced condition.
  3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Recommend corrective action to align design and actual conditions.
  4. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
  5. Do not make fan-speed adjustments that result in motor loading greater than full load amps. Do not increase fan speed beyond fan class rating. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
  6. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.

### 3.11 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper operators.
- F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Verify main control supply-air pressure and observe compressor and dryer operations.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

### 3.12 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, 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: As Work progresses, prepare 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.

### 3.13 FINAL REPORT

- A. General: Computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
  - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the 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, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
  - 1. Title page.
  - 2. Name and address of testing, adjusting, and balancing Agent.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of testing, adjusting, and balancing Agent who certifies the report.
  - 10. Summary of contents, including the following:
    - a. Design versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  - 11. Nomenclature sheets for each item of equipment.
  - 12. Data for terminal units, including manufacturer, type size, and fittings.
  - 13. Notes to explain why certain final data in the body of reports vary from design values.
  - 14. Test conditions for fans and pump performance forms, including the following:
    - a. Settings for outside-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings, including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.

- E. Air-Handling Unit Test Reports: For heat pumps, include the following:
1. Unit Data: Include the following:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Sheave dimensions, center-to-center and amount of adjustments in inches.
    - j. Number of belts, make, and size.
    - k. Number of filters, type, and size.
  2. Motor Data: Include the following:
    - a. Make and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Sheave dimensions, center-to-center and amount of adjustments in inches.
  3. Test Data: Include design and actual values for the following:
    - a. Total airflow rate in cfm (L/s).
    - b. Total system static pressure in inches wg (Pa).
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg (Pa).
    - e. Filter static-pressure differential in inches wg (Pa).
    - f. Preheat coil static-pressure differential in inches wg (Pa).
    - g. Cooling coil static-pressure differential in inches wg (Pa).
    - h. Heating coil static-pressure differential in inches wg (Pa).
    - i. Outside airflow in cfm (L/s).
    - j. Return airflow in cfm (L/s).
    - k. Outside-air damper position.
    - l. Return-air damper position.
    - m. Vortex damper position.
- F. Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data: Include the following:
    - a. System and air-handling unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F (deg C).
    - d. Duct static pressure in inches wg (Pa).
    - e. Duct size in inches.
    - f. Duct area in SF.
    - g. Design airflow rate in cfm (L/s).
    - h. Design velocity in fpm (m/s).
    - i. Actual airflow rate in cfm (L/s).
    - j. Actual average velocity in fpm (m/s).
    - k. Barometric pressure in PSIG (Pa).

- G. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
1. Unit Data: Include the following:
    - a. Unit identification.
    - b. Location.
    - c. Unit make and model number.
    - d. Manufacturer's compressor serial numbers.
    - e. Compressor make.
    - f. Compressor model and serial numbers.
    - g. Refrigerant weight in lb (kg).
    - h. Low ambient temperature cutoff in deg F (deg C).
  2. Test Data: Include design and actual values for the following:
    - a. Inlet-duct static pressure in inches wg (Pa).
    - b. Outlet-duct static pressure in inches wg (Pa).
    - c. Entering-air, dry-bulb temperature in deg F (deg C).
    - d. Leaving-air, dry-bulb temperature in deg F (deg C).
    - e. Condenser entering-water temperature in deg F (deg C).
    - f. Condenser leaving-water temperature in deg F (deg C).
    - g. Condenser water temperature differential in deg F (deg C).
    - h. Condenser entering-water pressure in feet of head or PSIG (kPa).
    - i. Condenser leaving-water pressure in feet of head or PSIG (kPa).
    - j. Condenser water pressure differential in feet of head or PSIG (kPa).
    - k. Control settings.
    - l. Unloader set points.
    - m. Low-pressure-cutout set point in PSIG (kPa).
    - n. High-pressure-cutout set point in PSIG (kPa).
    - o. Suction pressure in PSIG (kPa).
    - p. Suction temperature in deg F (deg C).
    - q. Condenser refrigerant pressure in PSIG (kPa).
    - r. Condenser refrigerant temperature in deg F (deg C).
    - s. Oil pressure in PSIG (kPa).
    - t. Oil temperature in deg F (deg C).
    - u. Voltage at each connection.
    - v. Amperage for each phase.
    - w. The kW input.
    - x. Crankcase heater kW.
    - y. Number of fans.
    - a`. Condenser fan rpm.
    - aa. Condenser fan airflow rate in cfm (L/s).
    - ab. Condenser fan motor make, frame size, rpm, and horsepower.
    - ac. Condenser fan motor voltage at each connection.
    - ad. Condenser fan motor amperage for each phase.
- H. Instrument Calibration Reports: For instrument calibration, include the following:
1. Report Data: Include the following:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

## 3.14 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION

## SECTION 230700 - HVAC INSULATION

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work Included: Provision of materials, installation and testing of:
  - 1. Type 2, Flexible Elastomeric Insulation

## 1.2 RELATED SECTIONS

- A. Contents of Division 23 and Division 01, General Requirements apply to this section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Piping Insulation products to contain less than 0.1% by weight PBDE in all insulating materials across the board.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Installer qualifications.
  - 2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any) for each type of product indicated.
  - 3. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.
  - 4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
  - 5. Submit manufacturer's installation instructions.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Installer to have minimum 5 years experience in the business of installing insulation.

## 1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00 and Division 01, General Requirements.

### 1.7 FIRE HAZARD CLASSIFICATION

- A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a flame spread of 25, fuel contributed of 50 and smoke developed of 50 as tested by ASTM E84 (NFPA 255) method.
- B. Test pipe insulation in accordance with the requirements of UL "Pipe and Equipment Coverings R5583 400 8.15."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Type 2, Flexible Elastomeric Insulation:
  - 1. Armacell LLC Armaflex.
  - 2. Or approved equivalent.

### 2.2 TYPE 2, FLEXIBLE ELASTOMERIC INSULATION

- A. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
  - 1. Thermal Conductivity Value: 0.25 BTU\*in/(hr\*sf°F) at 75 degrees F.
  - 2. Maximum Service Temperature of 220 degrees F.
  - 3. Maximum Flame Spread: 25.
  - 4. Maximum Smoke Developed: 50 (1-inch thick and below).
  - 5. Connection: Waterproof vapor retarder adhesive as needed.
  - 6. UV Protection: UV outdoor protective coating per manufacturers requirements.
- B. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam. Armacell LLC Armaflex Low VOC adhesive, Halstead, or approved equivalent.

## PART 3 - EXECUTION

### 3.1 VERIFICATION OF CONDITIONS

- A. Do not apply insulation until pressure testing of the ducts and piping has been completed. Do not apply to pipe with heat tracing until system has been tested. Do not apply insulation until the duct has been inspected.
- B. Examine areas and conditions under which duct insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and dry surfaces to be insulated.

3.3 INSTALLATION

- A. Insulation: Continuous through walls, floors, partitions except where noted otherwise.
- B. Piping:
  - 1. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.

3.4 PROTECTION AND REPLACEMENT

- A. Installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

3.5 PIPING SURFACES TO BE INSULATED

- A. Oregon:

Item to be Insulated	System Insulation Type	Pipe Size	Insulation Thickness
Refrigeration Suction Piping	2	All	1-1/2-inch

- B. Note: Insulation thickness shown is a minimum. If state code requires additional thickness, then provide insulation thickness per code requirements.

3.6 INSULATED PIPE EXPOSED TO WEATHER

- A. Where piping is exposed to weather, cover insulation with aluminum jacket. Seal watertight jacket per manufacturer's recommendations. Install with exposed lap pointing down. Provide heat tracing on piping subject to freezing. See Section 23 05 33.

3.7 FLEXIBLE ELASTOMERIC PLASTIC PIPE INSULATION

- A. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with two coats of finish as recommended by manufacturer.

3.8 PROTECTION AND REPLACEMENT

- A. Protect installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

END OF SECTION



## SECTION 230900 - INSTRUMENTATION AND CONTROL PERFORMANCE SPECIFICATIONS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work Included: Materials, installation and testing of:
  - 1. Communications
  - 2. Application Specific Controllers
  - 3. Input/Output Interface
  - 4. Control Panels
  - 5. Auxiliary Control Devices
  - 6. Wiring and Raceways

## 1.2 RELATED SECTIONS

- A. Contents of Division 23 and Division 01, General Requirements apply to this section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. UL 916 Underwriters Laboratories Standard for Energy Management Equipment, Canada and the US.
  - 2. FCC Part 15, Subpart J, Class A.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Prepare and submit a detailed schedule of work. Schedule to identify milestones such as equipment submittals, control panel diagrams, color graphic panel displays, Interlock.
  - 2. Wiring diagrams, control program sequence software flow chart diagrams, conduit layout diagrams, device location diagrams, equipment and component deliveries, installation sequencing, controller startup, point to point startup, control programming, sequence testing, commissioning/acceptance testing and training.
  - 3. Submit design drawings, sequences of operation, program listings, software flow charts and details for each typical piece of equipment and system being controlled. No work to be initiated or fabrication of any equipment started prior to the Owner's Representatives return of REVIEWED submittals.
  - 4. Format: Make each submittal in one complete and contiguous package. partial or unmarked submittals will be rejected without review.
  - 5. Submit Manufacturers Data as follows:
    - a. Complete materials list of items proposed to be furnished and installed. A complete Bill of Materials, listing materials, components, devices, wire and equipment are required for this work. The Bill of Materials to be separate for each controller on its own page(s) and to contain the following information for each item listed:
      - 1) Manufacturer's Name and Model number with furnished options highlighted.
      - 2) Quantity of each by controller location.

- 3) Description of product (generic).
  - 4) Specified item.
  - 5) Operating range or span.
  - 6) Operating point or setpoint.
  - b. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements, including but not limited to: Catalog cuts, technical data and descriptive literature on hardware, software, and system components to be furnished.
  - c. The data to be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data. Submit printed manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials and including printed installation instructions and start-up instructions.
  - d. Unless specifically called for otherwise, provide bound copies of catalog cuts for standard products, not requiring specifically prepared Shop Drawings, for the following:
    - 1) Wire and cable, Class II.
    - 2) Face plates for devices.
    - 3) Disconnect switches for power control.
  - e. Where more than one item, size, rating or other variations appear on a catalog cut sheet, clearly identify items to be provided. These items to be properly indexed and referenced to identification numbers, designations and/or details on the Drawings.
6. Shop drawings: Submit shop drawings for each controlled system, depicting the following information:
- a. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves and other control/monitoring devices.
  - b. Label each control device with initial setting or adjustable range of control. Label points in schematic diagrams with termination at corresponding controller.
  - c. Electrical wiring. Clearly differentiate between portions of wiring that are factory installed and portions of be field-installed.
  - d. Details of control panel faces, including controls, instruments, and labeling.
  - e. Interfaces to equipment furnished under other Sections identifying numbers of wires, termination location, voltages and pertinent details. Responsibility for each end of the interfaces to be noted on these drawings whether or not they are a part of this Section.
7. Equipment locations, wiring and piping schematics, details, panel configurations, sizes, damper motor mounting details, valve schedules, and a point list keyed to specific hardware SUBMITTALS. Control wiring depicted as fully annotated ladder diagrams with terminations identified, completely configured as to the exact panel, wiring, relay, switch, and component configuration.
8. Tag number lists: Develop instruments tag number system and submit list for approval. Coordinate methods and number block with the Owner Representative.
9. Format the Shop and Field Drawings to include:
- a. A Title Sheet containing a drawing list, abbreviations list, symbols list, site and vicinity maps for project location and schedules.
  - b. Floor Plans showing proposed device locations and device nomenclatures.
  - c. A Riser Diagram illustrating conduit relationships between devices shown on the Floor Plans. Show device nomenclatures.
  - d. A Single-Line Diagram for each system showing signal relationships of devices within the system. Show device nomenclatures.
  - e. A Wiring Diagram for each assembly, enclosure or free standing device, showing:
    - 1) The devices within
    - 2) Wiring connections
    - 3) Wire identification
    - 4) Voltage levels
    - 5) Fuse ratings

- f. Operations and Maintenance Manuals:
  - 1) Following approval of Shop Drawings of control equipment and prior to acceptance of control work, prepare Operating and Maintenance manuals describing operating, servicing, and maintenance requirements of control systems and equipment installed under this Section, in accordance the General and Special Conditions of these Specifications.
  - 2) Information contained in the manual for the above equipment to include the following:
    - (a) Manufacturer's catalog cuts and printed descriptive bulletins.
    - (b) Manufacturer's installation, operating, and maintenance instruction booklets. Complete instructions regarding the operation and maintenance of equipment involved.
    - (c) Instrument calibration certificates.
    - (d) Parts list and costs.
    - (e) Complete nomenclature of replaceable parts, list of recommended spare parts for 12 months operation, their part numbers, current cost and name and address of the nearest vendor of replacement parts.
    - (f) Name, address and telephone number for closest source of spare parts.
    - (g) Wiring and schematic diagrams.
    - (h) Include final record copies of shop drawings.
    - (i) Copy of guarantees and warranties issued for the various items of equipment, showing dates of expiration.
    - (j) Reduced plans, diagrams, and control schematics.
    - (k) Copies of test results.
    - (l) Control System Operating Manual including: point of summary and point data base; complete printout of program listings; magnetic tape CD or DVD backup of Field Control Cabinet programs; cabinet layout; hard copy of graphic screens; hard copy of specified reports.
- g. A final Bill of Quantities including a separate schedule for portable equipment, if delivered as part of this work.
- h. Performance, Test and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified in these specifications.

#### 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00 and Division 01, General Requirements.

#### 1.6 WARRANTY

- A. Warranty of materials and workmanship as required by in Section 23 00 00 and Division 01, General Requirements.

#### 1.7 SYSTEM DESCRIPTION

- A. Control system referenced throughout specifications and drawings as Building Automation System (BAS), Building Management System (BMS), or Energy Management System (EMS) interchangeably consists of high-speed, peer-to-peer network of DDC controllers, control system server, and/or operator workstation.
- B. Existing control system server and/or operator workstation provides for overall system supervision and configuration, graphical user interface, management report generation, and alarm annunciation.
- C. System supports web browser access to building data. Remote user using standard web browser be able to access control system graphics and change adjustable setpoints with proper password.

- D. Local Area Network (LAN) either 10 or 100 Mbps Ethernet network.
- E. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation valves and dampers.
- F. Prepare individual hardware layouts, interconnection drawings, building riser/architecture diagram and sequence of control from the project design data.
- G. Design, provide, and install equipment cabinets, panels, data communication network infrastructure (including cables, conduits, outlets, connections, etc.) needed, and associated hardware.
- H. Provide complete manufacturer's specifications for items that are supplied. Include vendor name and model number of every item supplied.
- I. Provide a comprehensive operator and technician training program as described in these specifications.
- J. Provide as-built documentation, operator's terminal software, diagrams, and other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- K. Provide 120V power, voltage power, transformers, etc. for control panels, transformer panels, and BAS devices. Install per Division 26 specifications. Power for devices within this specification section are solely the responsibility of the BAS Contractor.
- L. Conduit and raceway systems. Install per Division 26 specifications.

#### 1.8 SYSTEM PERFORMANCE

- A. Performance Standards. System conforms to following minimum standards over network connections:
  - 1. Graphic Display. Graphic with 20 dynamic points display with current data within 10 seconds.
  - 2. Graphic Refresh. Graphic with 20 dynamic points update with current data within 8 seconds.
  - 3. Object Command. Devices react to command of binary object within 2 seconds. Devices begin reacting to command of analog object within 2 seconds.
  - 4. Object Scan. Data used or displayed at controller or workstation have been current within previous 6 seconds.
  - 5. Alarm Response Time. Object that goes into alarm be annunciated at workstation within 45 seconds.
  - 6. Program Execution Frequency. Custom and standard applications be capable of running as often as once every 5 seconds. Select execution times consistent with mechanical process under control.
  - 7. Performance. Programmable controllers be able to completely execute DDC PID control loops at frequency adjustable down to once per second. Select execution times consistent with mechanical process under control.
  - 8. Multiple Alarm Annunciation. Each workstation on network receive alarms within 5 seconds of other workstations.

- B. Reporting Accuracy. System reports values with minimum end-to-end accuracy listed in Table Number
  1. TABLE 1
  2. Reporting Accuracy

Measure Variable	Reported Accuracy
Space Temperature	±1°F
Ducted Air	±1°F
Outside Air	±2°F
Dew Point	±3°F
Water Temperature	±1°F
Delta-T	±0.25°F
Relative Humidity	±5 percent RH
Water Flow	±2 percent of full scale

3. Note 1: Accuracy applies to 10 percent-100 percent of scale
4. Note 2: For both absolute and differential pressure
5. Note 3: Not including utility-supplied meters

- C. Control Stability and Accuracy. Control loops maintain measured variable at setpoint within tolerances listed in Table 2.

- D. TABLE Number 2
  1. Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	+0.2 in w.g.	0-6 inc. w.g.
	+0.01 in w.g.	-0.1 to 0.1 in w.g.
Airflow	+10 percent of full scale	
Space Temperature	+2.00F	
Duct Temperature	+30F	
Humidity	+5 percent RH	
Fluid Pressure	+1.5 PSI	1-150 PSI
	+1.0 in w.g.	0-50 in w.g. differential

PART 2 - PRODUCTS

2.1 MANUFACTURERS/INSTALLERS

- A. Siemens Apogee

## 2.2 COMMUNICATIONS

- A. Each controller to have communication port for connection to operator interface.
  - 1. Internetwork operator interface and value passing to be transparent to internetwork architecture.
  - 2. Operator interface connected to controller to allow operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, reports, system software, and custom programs to be viewable and editable from each internetwork controller.
- B. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers to be readable by each controller on internetwork.
- C. Operator Workstation to be capable of simultaneous direct connection and communication with BACnet/IP, OPC and TCP/IP networks without use of interposing devices such as PC or gateway with hard drive.
- D. Workstations, Building Control Panels and Controllers with real-time clocks use time synchronization service. System automatically synchronize system clocks daily from operator-designated device via internetwork. System automatically adjust for daylight savings and standard time as applicable.

## 2.3 APPLICATION SPECIFIC CONTROLLERS

- A. Application specific controllers (ASCs) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers to be fully programmable using graphical programming blocks.
  - 1. ASC controllers communicates with other devices on internetwork.
  - 2. Each ASC capable of stand-alone operation without being connected to network.
  - 3. Each ASC will contain sufficient I/O capacity to control target system.
  - 4. Application controllers to include universal inputs with minimum 10-bit resolution that accept thermistors, 0-10VDC, 0-5 VDC, 4-20 mA and dry contact signals. Any input on a controller may be either analog or digital with at least 1 input that accepts pulses. Controller to also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller to include binary and analog outputs on board. Provide analog outputs switch selectable as either 0-10VDC or 0-20mA. Software to include scaling features for analog outputs. Application controller to include 24VDC voltage supply for use as power supply to external sensors.
  - 5. Program sequences stored on board application controller in EEPROM. No batteries needed to retain logic program. Program sequences executed by controller 10 times per second and capable of multiple PI and PID loops for control of multiple devices. Calculations completed using floating-point math and system to support display of information in floating-point nomenclature at operator's terminal. Programming of application controller completely modifiable in the field over installed BAS LANs or remotely via modem interface. Operator to program logic sequences by graphically moving function blocks on screen and tying blocks together on screen.
  - 6. Application controller to include support for room sensor. Display on room sensor programmable at application controller and include an operating mode and a field service mode. Provide button functions and display data programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

- B. Communication:
  - 1. Controller resides on network using MS/TP Data Link/Physical layer protocol.
  - 2. Each controller connected to building controller.
  - 3. Each controller capable of connection to laptop computer or portable operator's tool.
- C. Environment
  - 1. Controllers used outdoors and/or in wet ambient conditions mounted within waterproof enclosures and rated for operation at 0 degrees F to 150 degrees F.
  - 2. Controllers used in conditioned space mounted in dust-proof enclosures and rated for operation at 32 degrees F to 120 degrees F.
- D. Serviceability: Provide diagnostic LEDs for power, communication, and processor.
- E. Memory. ASC use nonvolatile memory and maintains BIOS and programming information in event of power loss.

#### 2.4 INPUT/OUTPUT INTERFACE

- A. Input/output points protected such that shorting of point to itself, to another point, or to ground will cause no damage to controller. Input and output points protected from voltage up to 24 V.
- B. Binary inputs (BI or DI) allow monitoring of On/Off signals from remote devices. Binary inputs sense "dry contact" closure without external power (other than that provided by controller) being applied.
- C. Pulse accumulation input objects accept up to 10 pulses per second for pulse accumulation.
- D. Analog inputs (AI) allow monitoring of low-voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD).
- E. Binary outputs (BO or DO) provide for On/Off operation or pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers have three-position (On/Off/Auto) override switches and status lights. Outputs selectable for either normally open or normally closed operation.
- F. Analog outputs (AO) provide a modulating signal for control of end devices. Outputs provide either a 0 to 10 VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs on building controllers have status lights and two-position (AUTO/MANUAL) switch and adjustable potentiometer for manual override. Analog outputs not exhibit drift of greater than 0.4 percent of range per year.
- G. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms run zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

## 2.5 CONTROL PANELS

### A. Control Panels:

1. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures to be NEMA 12 when installed in other than a clean environment. Outdoor enclosures must be NEMA 3R. Provide (hinged door) key-lock latch and removable subpanels. Single key common to field panels and subpanels.
2. Interconnections between internal and face-mounted devices prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection individually identified per control drawings.
3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.
4. Provide laminated plastic nameplates for enclosures in any mechanical room or electrical room labeled with TCP number. Laminated plastic to be 1/8-inch thick sized appropriately to make label easy to read.

## 2.6 AUXILIARY CONTROL DEVICES

### A. Temperature Instruments:

1. Room Temperature Sensor: Thermistor or platinum RTD type with accuracy of  $\pm 0.5$  degrees F at 70 degrees F; operating range 30-120 degrees F; linear signal; single point sensing element in wall-mounted ventilated enclosure with insulating back plate if mounted on exterior wall; push button for occupancy override; digital set point adjustment; LCD temperature display indicating setpoint only.
2. Averaging Duct Temperature Sensors: Thermistor or platinum RTD element with accuracy of  $\pm 0.5$  degrees F at 32 degrees F, consisting of array of single point sensing elements, securely mounted in duct or plenum; operating range 20-120 degrees F; linear signal; 1-foot element per 2 SF of duct cross sectional area. Use when duct is 9 SF or larger or where air is subject to temperature stratification.
3. Probe Duct Temperature Sensors: Thermistor or platinum RTD element with accuracy of  $\pm 0.5$  degrees F at 32 degrees F, consisting of single point sensing elements, securely mounted in duct or plenum; operating range 20-120 degrees F; linear signal; 24-inch rigid probe. Use where duct is less than 9 SF cross sectional area.
4. Outside Air Temperature Sensor: Thermistor or platinum RTD element with accuracy of  $\pm 0.5$  degrees F at 32 degrees F; Range -58-120 degrees F, single element, linear, with weather and sun shield for exterior mounting.

### B. Electric Damper Actuators.

1. Provide mechanical or electronic stall protection for each actuator.
2. Where indicated provide internal mechanical, spring-return mechanism or provide uninterruptible power supply (UPS). Non-spring-return actuators have external manual gear release to position damper/valve when actuator is not powered.
3. Proportional actuators accepts 0 to 10 VDC or 0 to 20 mA control signal and provide 2 to 10 VDC or 4 to 20 mA operating range.
4. Actuator sized for torque required plus 25 percent; UL or CSA listed; electronic current overload protection.



- C. Duct Mounted Carbon Dioxide Sensor:
  1. Duct mounted CO<sub>2</sub> sensor consists of infrared sensing element with heated stannic dioxide semiconductor. Operating range 0-2000 ppm + 50 ppm + 2 percent of measured value; maximum duct velocity of 1500 fpm; duct mounting kit.
  
- D. Wall Mounted Space Carbon Dioxide Sensor:
  1. Sensor to employ non-dispersive infrared technology. (N.D.I.R.)
  2. Sensor repeatability: +/- 20 ppm. 0-2000.
  3. Sensor accuracy: <= 75 ppm over 0-1500 ppm range.
  4. Sensor response time: less than 1 minute.
  5. Sensor to employ reference channel design for long-term stability.
  6. Sensor to have field selectable 0-10VDC, or 4-20mA outputs.
  7. Sensor power requirement less than 3W.
  8. Sensor input voltage: 20 to 30VAC/DC.
  9. Sensor operating temperature range: 0 °C to 50 °C.
  10. Sensor to have models for wall mounting or duct mounting.
  11. Sensor to provide at least a 1-year factory warranty from date of purchase.
  12. Sensor to match cover in color and look to temperature sensor.
  13. Manufacturers:
    - a. Telaire.
    - b. Vaisala.
    - c. Veris.
  
- E. Relays
  1. Control relays UL listed plug-in type with dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage be suitable for application.
  2. Time delay relays UL listed solid-state plug-in type with adjustable time delay. Delay adjustable ±200 percent (minimum) from set point or as indicated. Contact rating, configuration, and coil voltage be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.
  
- F. Current transmitters:
  1. AC current transmitters be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4 to 20 mA two-wire output. Unit ranges 100 A full scale, with internal zero and span adjustment and ±1 percent full-scale accuracy at 500 ohm maximum burden.
  2. Transmitter meets or exceeds ANSI/ISA S50.1 requirements and UL/CSA recognized.
  3. Unit split-core type for clamp-on installation on existing wiring.
  
- G. Current Transformers: AC current transformers UL/CSA recognized and completely encased (except for terminals) in approved plastic material; ±1 percent accuracy at 5 A full-scale.
  
- H. End Switches: Turret head type SPDT. Square D Class 9007, Type C54B2, or equal.

## 2.7 WIRING AND RACEWAYS

- A. General: Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
- B. Insulated wire to be copper conductors, UL labeled for 90 degrees C minimum service.

- C. Field and Subfield Panels: Voltage in panels not exceed 120 volts.
- D. Wiring for BAS systems communications buses two conductor minimum 18 gauge foil-shielded, stranded twisted pair cable rated at 300 VDC or more than 80 degrees C.

### PART 3 - EXECUTION

#### 3.1 DEMOLITION

- A. Terminal Devices: Remove terminal sensors, actuators and controls as indicated on drawings and as required to accommodate scope of mechanical work shown on drawings and described in specifications. Remove pneumatic piping and cap with hardware as appropriate. Remove wiring and conduit associated with devices. Do not leave any unused abandoned piping or wiring in space.
- B. Graphics and Programming: Remove symbols from control system graphics associated with deleted terminal elements. Modify programming code to delete alarms, control loops, etc., associated with deleted terminal devices.

#### 3.2 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- B. Notify the Owners' representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until unsatisfactory conditions are resolved.

#### 3.3 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Testing completed before Owner's representative is notified of system demonstration.
- B. Calibrate and prepare for service of instruments, controls, and accessory equipment furnished under this specification.
- C. Verify that control wiring is properly connected and free of shorts and ground faults.
- D. Enable control systems and verify calibration and operation of input and output devices.
- E. Verify that system operation adheres to sequences of operation.
- F. Commissioning and verification: In addition to commissioning requirements specified elsewhere, provide the following commissioning on the HVAC instrumentation and controls system:
  - 1. Control systems completely commissioned to ensure aspects of the system are operating as intended and at optimum tuning.
  - 2. Wiring connections verified and traced from field device to panel to ensure proper connections.
  - 3. Measured values verified by a hand held calibrated device to validate that value indicated by the control system is in fact the actual measured value.
  - 4. Loops properly tuned to obtain the desired control value. Each loop to be "upset" and put back in control to demonstrate its ability to stabilize quickly.
  - 5. Provide a final point-by-point report submitted that indicates the date of each verification, the results, and initialed on each page by the person performing the reading.

### 3.4 ACCEPTANCE TESTING AND TRAINING

- A. Site Testing:
  - 1. Contractor provides personnel, equipment, instrumentation, and supplies necessary to perform testing. Owner or Owner's representative will witness and sign off on acceptance testing.
  - 2. Contractor demonstrates compliance of completed control system with Contract Documents. Using approved test plan, physical and functional requirements of project demonstrated.
- B. Training:
  - 1. General: Contractor conducts training courses for up to 3 other designated personnel in operation and maintenance of system. Training manuals provided for each trainee, with two additional copies provided for archival at project site. Manuals include detailed description of subject matter for each lesson. Copies of audiovisuals delivered to Owner. Training day is defined as 8 hours of classroom instruction, including two 15-minute breaks and excluding lunch time, Monday through Friday, during normal first shift in effect at training facility. Notification of any planned training given to Owner's representative at least 15 days prior to training.
  - 2. Taught at project site for period of one half training day no later than six months after completion of the acceptance test. Course will be structured to address specific topics that students need to discuss and to answer questions concerning operation of system. Upon completion, students should be fully proficient in system operation and have no unanswered questions regarding operation of installed system.

### 3.5 WIRING

- A. Provide electrical wiring required to control systems specified in this section. Control and interlock wiring complies with national, state and local electrical codes and Division 26 of this specification.
- B. Power wiring required for building control panel(s) to be dedicated circuit(s).
- C. Verify location of operator work station with Owner prior to installation.
- D. NEC Class 1 (line voltage) wiring UL Listed in approved raceway according to NEC and Division 26 requirements.
- E. Low-voltage wiring meets NEC Class 2 requirements. (Low-voltage power circuits subfused when required to meet Class 2 current limit.)
- F. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL Listed for intended application.
- G. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for purpose of interfacing (e.g., relays and transformers).
- H. Where Class 2 wiring is run exposed, wiring is to be run parallel along surface or perpendicular to it and tied at 10 ft intervals.
- I. Where plenum cables are used without raceway, supported from structural members. Cables not to be supported by ductwork, electrical raceways, piping, or ceiling suspension systems.

- J. Wire-to-device connections made at terminal block or terminal strip. Wire-to-wire connections at terminal block.
- K. Maximum allowable voltage for control wiring 120 V. If only higher voltages are available, provide step-down transformers.
- L. Wiring installed as continuous lengths, with no splices permitted between termination points.
- M. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at penetrations.
- N. Include one pull string in each raceway 1 in. or larger.
- O. Control and status relays are to be located in designated enclosures. Enclosures include packaged equipment control panels unless they also contain Class 1 starters.
- P. Install raceway to maintain a minimum clearance of 6 in. from high-temperature equipment (e.g., steam pipes or flues).
- Q. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- R. Install insulated bushings on raceway ends and openings to enclosures. Seal top end of vertical raceways.
- S. Flexible metal raceways and liquid-tight, flexible metal raceways not-to-exceed 3-feet in length and be supported at each end. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways to be used.
- T. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections joined with couplings. Terminations made with fittings at boxes.

### 3.6 COMMUNICATION WIRING

- A. Follow manufacturer's installation recommendations for communication cabling.
- B. Verify integrity of network following cable installation.
- C. Communication wiring unspliced length when that length is commercially available; labeled to indicate origination and destination data.
- D. Grounding of coaxial cable in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

### 3.7 INSTALLATION OF AUXILIARY CONTROL DEVICES

#### A. General:

1. Install sensors in accordance with manufacturer's recommendations.
2. Room sensors installed on concealed junction boxes properly supported by wall framing.
3. Low-limit sensors used in mixing plenums installed in a serpentine manner horizontally across duct.
4. Pipe-mounted temperature sensors installed in wells with heat-conducting fluid in thermal wells.
5. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.

#### B. Actuators:

1. General:
  - a. Mount and link control damper actuators according to manufacturer's instructions.
  - b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
2. Actuator Mounting for Damper arrangements to comply to the following:
  - a. Damper Actuators: Do not install in the air stream
  - b. Use a weather proof enclosure (clear and see through) if actuators are located outside.
  - c. Damper actuator ambient temperature not-to-exceed 122 degrees F through any combination of medium temperature or surrounding air. Provide appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation as necessary. Mount per manufacturer's recommendations.
  - d. Actuator cords or conduit to incorporate a drip leg if condensation is possible. Do not allow water to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point to be avoided to prevent water from condensing in conduit and running into actuator.
  - e. Damper mounting arrangements to comply to the following:
    - 1) Furnish and install damper channel supports and sheet metal collars.
    - 2) Jack shafting of damper sections not allowed.
    - 3) Multi-section dampers arranged so that each damper section operates individually. Provide one electronic actuator direct shaft mounted per section.
  - f. Size damper sections based on actuator manufacturers specific recommendations for face velocity, differential pressure and damper type. In general: Damper section not-to-exceed 24 ft-sq. with face velocity 1500 FPM.
  - g. Multiple section dampers of two or more arranged to allow actuators to be direct shaft mounted on the outside of the duct.
  - h. Multiple section dampers of three or more sections wide arranged with a 3-sided vertical channel (8-inch wide by 6-inch deep) within the duct or fan housing and between adjacent damper sections. Vertical channel anchored at the top and bottom to the fan housing or building structure for support. Connect sides of each damper frame to the channels. Holes in the channel to allow damper drive blade shafts to pass through channel for direct shaft mounting of actuators. Face open side of channel down stream of the airflow, except for exhaust air dampers.
  - i. Multiple section dampers to be mounted flush within a wall or housing opening to receive either vertical channel supports as described above or sheet metal standout collars. Sheet metal collars (12-inch minimum) to bring each damper section out of the wall to allow direct shaft mounting of the actuator on the side of the collar.

### 3.8 SEQUENCES OF OPERATION

- A. Where local energy code dictates certain sequences (such as night setback, night flush, terminal unit sequences, etc.), the sequences are not repeated in the documents. It is not the intent of this specification or documentation to reiterate the energy code. Energy code mandated sequences are to be provided.
- B. Fan Coil (FC) and Condensing Unit:
1. Fan coil controller receives signal from building controller, which initiates occupied or unoccupied mode. Manual switch on room temperature sensor overrides unoccupied mode for predetermined time period. During unoccupied mode space temperature reset to night setback set points and during occupied mode space temperature reset to occupied set points.
  2. Occupied Mode:
    - a. Fan runs continuously.
    - b. Room temperature sensor signals controller which in sequence modulate normally open heating coil control valve and stages condensing unit.
  3. Unoccupied Mode:
    - a. Normally open heating coil control valve and condensing unit off.
    - b. Space temperature sensor signals controller which starts fan and open normally closed cooling coil control valve to maintain cooling space temperature. When space has reached 2 degrees F below setup temperature, shut off fan and close cooling coil control valve.
    - c. Space temperature sensor signals unit controller which starts fan and open normally open heating coil control valve to maintain heating space temperature. When space has reached 2 degrees F above setback temperature, shut off fan and close cooling coil control valve.
  4. Warm-up Mode: Reheat coil controller receives global signal from building controller to initiate warm-up mode. During warm-up mode heating coil control valve is open.
- C. Rooftop Packaged Heat Pump:
1. General: Unit to operate under following modes: Occupied, Shutdown and Unoccupied. H-O-A switches on graphics screens or text dialog boxes may override on/off equipment.
  2. Occupied Mode:
    - a. Supply fan runs continuously and outside air damper open to minimum position.
    - b. Space temperature sensor signals controller which sequence mechanical cooling operation and stages of heating to maintain space temperature setpoint. Incorporate economizer cooling as the first stage of cooling when outside air temperature is less than return temperature.
  3. Shutdown Mode:
    - a. Supply fan off.
    - b. Mechanical cooling/heating and electric heater off.
  4. Unoccupied Mode:
    - a. Night Setback and Setup: Supply fan operates when any space temperature drops to 60 degrees F or below or rises to 85 degrees F or above in designated zones. Maintain fan operation until space temperature rises to 63 degrees F (heating) or 82 degrees F (cooling). When supply fan operates.
    5. Warm-up Control: Optimal start program initiates warm-up control. Supply fan operates during warmup. When space temperature reaches 70 degrees F for 30 minutes, switch to occupied mode.
    6. Unoccupied Mode Override: For each unit upon receiving "override" signal from designated space temperature sensors, controller changes space to occupied mode for period of 2 hours (adjustable).
    7. Alarms / Safeties:
      - a. Provide interface with fire alarm system. During fire alarm mode shutdown air handling units.
      - b. Current transformer located in fan power circuit signals controller in event of fan/control failure. An alarm generated.

## 3.9 POINTS LIST

## A. Heat Pumps:

	<b>Analog In</b>	<b>Analog Out</b>	<b>Digital In</b>	<b>Digital Out</b>	<b>Alarms</b>
Discharge Air Temperature	X				
Space Temperature	X				High/Low
Supply Fan On/Off				X	
Supply Fan Status			X		Fail
Heating Command				X	
Cooling Command				X	
Outside Air Damper		X			
Space Carbon Dioxide (ppm)	X				High/Low

## B. Fan Coil/Condensing Unit:

	<b>Analog In</b>	<b>Analog Out</b>	<b>Digital In</b>	<b>Digital Out</b>	<b>Alarms</b>
Space Temperature 1	X				High/Low
Space Temperature 2	X				High/Low
Discharge Air Temperature	X				
Supply Fan Start/Stop				X	
Supply Fan Status			X		Fail
Cooling Stage 1				X	
Cooling Stage 2				X	

END OF SECTION

## SECTION 232300 - REFRIGERANT PIPING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work included: Provision of materials, installation and testing of:
  - 1. Piping
  - 2. Refrigerant

## 1.2 RELATED SECTIONS

- A. Contents of Division 23 and Division 01, General Requirements apply to this Section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00 and Division 01, General Requirements.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Product Data: For each type of valve and refrigerant piping specialty indicated, include pressure drop, based on manufacturer's test data for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.
  - 2. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.
    - a. Refrigerant piping indicated is schematic only. Size piping and design the actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.
  - 3. Welding Certificates: Copies of certificates for welding procedures and personnel.
  - 4. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
  - 5. Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals specified in Division 01.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX "Welding and Brazing Qualifications.
  - 2. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration.
  - 3. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."
  - 4. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical" or UL 429 "Electrically Operated Valves."



## 1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00 and Division 01, General Requirements.

## 1.7 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with Section 23 05 29 unless indicated otherwise.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers as specified in specific articles below.

### 2.2 PIPING

- A. Copper Tube: ASTM B 280, Type ACR, drawn-temper tube, clean, dry and capped. .
  - 1. Fittings: ASME B16.22 wrought copper.
  - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy (15 percent Silver).
- B. Copper Tube to 5/8-inch OD: ASTM B280. Tube ACR, annealed-temper copper tube, clean, dry and capped.
  - 1. Fittings: ASME B16.26 cast copper.
  - 2. Joints: Flared.

### 2.3 REFRIGERANT

- A. Refrigerant: Per manufacturer's recommendation.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### 3.2 INSTALLATION

- A. Install systems in accordance with ASHRAE Standard 15.
- B. Install refrigeration specialties in accordance with manufacturer's instructions.

- C. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and avoid interference with use of space.
- E. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- F. Provide non-conducting di-electric connection when joining dissimilar metals.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Provide access to concealed valves and fittings.
- K. Flood piping system with nitrogen when brazing.
- L. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting.
- N. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

### 3.3 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test system with dry nitrogen to 200 PSI . Perform final tests at 27-inches vacuum and 200 PSI using electronic leak detector. Test to no leakage.

END OF SECTION

## SECTION 236200 - PACKAGED AIR-COOLED REFRIGERANT COMPRESSOR AND CONDENSOR UNITS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work Included: Provision of materials, installation and testing of:
  - 1. Manufactured Units
  - 2. Casing
  - 3. Condenser Coils
  - 4. Fans and Motors
  - 5. Compressors
  - 6. Refrigerant Circuit
  - 7. Controls

## 1.2 RELATED SECTIONS

- A. Contents of Division 23 and Division 01, General Requirements apply to this section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00 and Division 01, General Requirements.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00 and Division 01, General Requirements.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00 and Division 01, General Requirements.

## 1.6 WARRANTY

- A. Warranty of materials and workmanship as outlined in Section 23 00 00 and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Five year warranty on compressor(s).

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. The Trane Company

## 2.2 MANUFACTURED UNITS

- A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, and screens.

- B. Performance Ratings: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE Std 90.1, or state energy code, whichever is more stringent.

### 2.3 CASING

- A. House components in galvanized steel panels with weather resistant, baked enamel finish.
- B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.
- C. Provide removable access doors or panels with quick fasteners.

### 2.4 CONDENSER COILS

- A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 425 PSIG, and dehydrate. Seal.
- B. Coil Guard: PVC coat steel wire.

### 2.5 FANS AND MOTORS

- A. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built in thermal overload protection.
- B. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge.

### 2.6 COMPRESSORS

- A. Compressor: Hermetic scroll type.
- B. Mounting: Statically and dynamically balance rotating parts and mount on rubber-in-shear vibration isolators.
- C. Lubrication System: Centrifugal oil pump with oil charging valve, oil level sight glass, and magnetic plug or strainer.
- D. Motor: Constant speed 1800 rpm suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting. Furnish with starter.
- E. Capacity Reduction Equipment: Suction valve unloaders, with lifting mechanism operated by electrically actuated solenoid valve, with unloaded compressor start; controlled from suction pressure.
- F. Sump Oil Heater: Evaporates refrigerant returning to sump during shut down. Energize heater thermostatically.

### 2.7 REFRIGERANT CIRCUIT

- A. Provide each unit with two independent refrigerant circuits, factory supplied and piped. Refer to Section 23 23 00.

- B. For each refrigerant circuit, provide:
  1. Filter dryer.
  2. Liquid line sight glass and moisture indicator.
  3. Thermal expansion valve for maximum operating pressure.
  4. Insulated suction line.
  5. Suction and liquid line service valves.
  6. Liquid line solenoid valve.
  7. Charging valve.
  8. Discharge line check valve.
  9. Compressor discharge service valve.
  10. Condenser pressure relief valve.
  
- C. For heat pump units, provide reversing valve, suction line accumulator, discharge muffler; flow control check valve, and solid-state defrost control utilizing thermistors.

## 2.8 CONTROLS

- A. On unit, mount weatherproof steel control panel, NEMA 250, containing power and control wiring, factory wired with single point power connection. .
  
- B. For each compressor, provide part winding starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset current overload protection. For each condenser fan, provide across-the-line starter with starter relay.
  
- C. Provide safety controls arranged so any one will shut down machine:
  1. High discharge pressure switch (manual reset).
  2. Low suction pressure switch (automatic reset).
  3. Oil Pressure switch (manual reset).
  
- D. Provide for the following operating controls:
  1. Multi-stage cooling input room cycles compressors activates solenoid valves in refrigerant circuit.
  2. Five minute off timer prevents compressor from short cycling.
  3. Periodic pump-out timer to pump down on high evaporator refrigerant pressure.
  4. Low ambient temperature controls.
  5. Hot gas bypass sized for minimum compressor loading on one compressor only, bypasses hot refrigerant gas to evaporator.
  6. Lead-lag switch to alternate compressor operation.
  7. Low ambient thermostat to lock out compressor at low ambient temperatures.
  
- E. Provide controls to permit operation down to 0 degrees F (-18 degrees C) ambient temperature.
  1. Thermostat to cycle fan motors in response to outdoor ambient temperature.
  2. Head pressure switch to cycle fan motors in response to refrigerant condensing pressure.
  3. Solid state control to vary speed of one condenser fan motor in response to refrigerant condensing pressure.
  4. Electronic control consisting of mixing damper assembly, controlled to maintain constant refrigerant condensing pressure.

- F. Gauges: Prepped for suction and discharge refrigerant pressures.
- G. For multiple units, provide remote mounted sequence panel to allow operation with lead-lag switching and time delay timer.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. Complete structural, mechanical, and electrical connections in accordance with manufacturer's installation instructions.
- C. Provide for connection to electrical service.
- D. Install units on vibration isolation.
- E. Install units on concrete base as indicated.
- F. Provide connection to refrigeration piping system and evaporators. Comply with ASHRAE Standards.

#### 3.2 STARTING EQUIPMENT AND SYSTEMS

- A. Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil or refrigerant prior to end of correction period.
- B. Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.
- C. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.
- D. Provide cooling season start-up, and winter season shut-down for first year of operation.
- E. Inspect and test for refrigerant leaks during first year of operation.

END OF SECTION

## SECTION 238143 - AIR-TO-AIR HEAT PUMPS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work included: Provision of materials, installation and testing of:
  - 1. Packaged Rooftop Heat Pumps

## 1.2 RELATED SECTIONS

- A. Contents of Division 23 and Division 01, General Requirements apply to this Section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00 and Division 01, General Requirements.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00 and Division 01, General Requirements.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00 and Division 01, General Requirements.
- B. In addition, meet the following:
  - 1. ARI 210/240-94, Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - 2. ARI 270-95, Sound Rating of Outdoor Unitary Equipment.

## 1.6 WARRANTY

- A. Warranty of materials and workmanship as outlined in Section 23 00 00 and Division 01, General Requirements.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Packaged Rooftop Heat Pumps:
  - 1. Carrier

## 2.2 PACKAGED ROOFTOP HEAT PUMPS

- A. One-piece, air-to-air electric heat pump designed to function as a year-round air conditioning system. Unit completely assembled and tested complete with refrigerant charge and ready to operate.
- B. Compressors: Provide two semihermetic or fully hermetic with crankcase heaters and vibration isolators; tested and designed in unit to operate to minus 20F OAT on heating cycle without shutting off; capable of operating to 25F OAT on cooling cycle. Provide 5-year warranty.

- C. Coils: Aluminum fins mechanically bonded to copper tubes, brazed joints.
- D. Fans and Motors:
  - 1. Indoor Air Fan: Centrifugal, belt drive with permanently lubricated bearings.
  - 2. Outdoor Fan: Direct-driven, permanently lubricated motor, upward discharge.
- E. Unit Cabinet: Galvanized steel baked enamel finish. Insulate cabinet interior with 1-inch thick neoprene coated fiberglass. Cabinet Panels: Removable for service to operating components. Provide condensate drain for indoor coil.
- F. Controls: High pressurestat, low pressurestats, loss-of-charge protection, and current and temperature sensitive overload devices.
- G. Outdoor Coil Defrost Control: Incorporate into the base unit to prevent frost accumulation during heating cycle; function on the basis of time and coil temperature. Timer to actuate a defrost mode if coil temperature is low enough to indicate frost condition. Defrost termination time maximum 10 minutes or when the defrost thermostat is satisfied. Electric resistance heaters operational automatically during the defrost cycle.
- H. Electrical Connections: Single-point to terminal block including electric heat.
- I. Roof Curb: Unit to sit in existing curb and match existing duct openings.
- J. Economizer: Return air and low-leak outdoor air (OA) dampers, barometric relief damper, outdoor air filter and hood and fully modulating electric control system with OA thermostat and adjustable mixed air thermostat, capable of introducing up to 100 percent outdoor air. Automatic control changeover from mechanical cooling to economizer operation through adjustable outdoor air changeover thermostat. Integrated type capable of simultaneous compressor and economizer operation. Dry bulb control.
- K. Electric Resistance Heaters: Open wire Nichrome elements with necessary safety and operating controls; UL listed.
- L. Anti-Short Cycle: Prevents compressor restart at least 5 minutes after shutdown.

### PART 3 - EXECUTION

#### 3.1 INSPECTION

- A. Examine areas and conditions under which units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

#### 3.2 EXAMINATION

- A. Verify that electric power is available and of the correct characteristics.



### 3.3 INSTALLATION

- A. Install in accordance with manufacturers instructions.
- B. Coordinate installation of unit with building components to allow adequate airflow to/from the units and for maintenance clearances. Mount outdoor units on a concrete housekeeping pad if above grade, or on a built-up roofing curb flashed and scaled in accordance with roofing warranty requirements.
- C. Provide adequate bracing and vibration isolation in accordance with seismic code requirements.
- D. Provide adequate drainage connections and routing for condensate.
- E. Provide shut off valves, site glasses, and routing pressure gauges, and all other appurtenances required for refrigerant system maintenance and operation.
- F. Provide filters for indoor units. Where outdoor units are installed, within 20 feet of trees, flowers plants, animals or other pollen or dander producing items, provide filters for outdoor units.

### 3.4 SYSTEM START-UP

- A. Set initial temperature set points. Instruct operating personnel in adjustment of setpoints and controls.

### 3.5 MAINTENANCE

- A. See Division 01 and Section 23 00 00 for additional requirements.
- B. Provide service and maintenance of units for one year from date of substantial completion.

### 3.6 SPARE PARTS

- A. Furnish to Owner, with receipt, for each packaged heating and cooling unit:
  - 1. One set matched fan belts for each belt-driven fan.
  - 2. One set filters for each unit.

END OF SECTION

## SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. Work included in 26 00 00 applies to Division 26 work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of electrical systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
  - 1. Provide: To furnish and install, complete and ready for intended use.
  - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
  - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
  - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01 requirements, and approved by the Engineer prior to submitting bids for substituted items.
  - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's representative, and other reviewing entity whose approval is required to obtain systems acceptance.

## 1.2 RELATED SECTIONS:

- A. Contents of Section applies to Division 26 Contract Documents.
- B. Related Work:
  - 1. Additional conditions apply to this Division including, but not limited to:
    - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
    - b. Drawings
    - c. Addenda
    - d. Owner/Architect Agreement
    - e. Owner/Contractor Agreement
    - f. Codes, Standards, Public Ordinances and Permits

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 26 sections and those listed in this section.

- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
1. State of Oregon:
    - a. OAR Oregon Administrative Rules
    - b. OESC Oregon Electrical Specialty Code
    - c. OFC Oregon Fire Code
    - d. OMSC Oregon Mechanical Specialty Code
    - e. OPSC Oregon Plumbing Specialty Code
    - f. OSSC Oregon Structural Specialty Code
    - g. OEESC Oregon Energy Efficiency Specialty Code
    - h. Oregon Elevator Specialty Code
- C. General: Reference standards and guidelines include but are not limited to the latest adopted editions from:
1. ADA Americans with Disabilities Act
  2. ANSI American National Standards Institute
  3. APWA American Public Works Association
  4. ASCE American Society of Civil Engineers
  5. ASHRAE Guideline, the Commissioning Process
  6. ASTM ASTM International
  7. CFR Code of Federal Regulations
  8. CSA CSA International
  9. EEMAC Electrical Equipment Manufacturers Association of Canada
  10. EPA Environmental Protection Agency
  11. ETL Electrical Testing Laboratories
  12. FCC Federal Communications Commission
  13. FDA Food & Drug Administration
  14. FM FM Global
  15. IEC International Electrotechnical Commission
  16. IEEE Institute of Electrical and Electronics Engineers
  17. IES Illuminating Engineering Society
  18. ISO International Organization for Standardization
  19. LEED Leadership in Energy and Environmental Design
  20. MSS Manufacturers Standardization Society
  21. NEC National Electric Code
  22. NEMA National Electrical Manufacturers Association
  23. NFPA National Fire Protection Association
  24. OSHA Occupational Safety and Health Administration
  25. UL Underwriters Laboratories Inc.
  26. USDA United States Department of Agriculture
- D. See Division 26 individual sections for additional references.
- E. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- F. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

## 1.4 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as individual Division 26 Sections.
- B. Provide product submittals and shop drawings in electronic format. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one zip file per specification division containing a separate file for each specification section. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.
- C. Product Data: Provide manufacturer's descriptive literature for products specified in Division 26 sections.
- D. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and drawings.
  - 1. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
  - 2. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Refer to individual Division 26 specification sections for specific items required in product data submittal outside of these requirements.
  - 3. See Division 26 individual sections for additional submittal requirements.
- E. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
- F. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-05 Chapter 13 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Building Occupancy Category 1, Category II, Category III, or Category IV, Seismic Design Category D. Equipment Importance Factor of 1.0.
  - 1. Special Seismic Certification to be provided for the following equipment and components that are part of the designated seismic system pursuant to Section 13.2.2, ASCE/SEI (Structural Engineers Institute).
    - a. Emergency and standby power systems equipment including generators, turbines, fuel tanks, and automatic transfer switches.
    - b. Switchgear.
    - c. Motor Control Centers.
    - d. Transformers.
    - e. Electrical substations.
    - f. UPS and associated batteries/racks.
    - g. Distribution panels including electrical panelboards, control panels, including fire alarm, and auxiliary or remote power supplies.
- G. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 26 Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26 submittals.

- H. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
- I. Substitutions and Variation from Basis-of-Design:
1. Basis-of-Design system components and controls for equipment are selected and sized based on the equipment specified as the first-named manufacturer, model number and supplemental additional options as indicated in the Contract Documents. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
- J. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Refer to individual Division 26 specification sections for additional requirements for shop drawings outside of these requirements.
1. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
- K. Samples: Provide samples when requested by individual sections.
- L. Resubmission Requirements:
1. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
    - a. Resubmit for review until review indicates no exceptions taken or make "corrections as noted".
    - b. When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.
- M. Operation and Maintenance Manuals, Owners Instructions:
1. Submit, at one time, electronic files (PDF format) on CD/DVD of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
    - a. Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
    - b. Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment.
    - c. Include Warranty per Division 00 and Division 01, Section 26 00 00 and individual Division 26 sections.
    - d. Include product certificates of warranties and guarantees.
    - e. Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
    - f. Include commissioning reports.

- g. Include copy of startup and test reports specific to each piece of equipment.
  - h. Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
- 2. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 26 00 00 Article titled "Demonstration".
  - 3. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
- N. Record Drawings:
- 1. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of conduit, and location of concealed electrical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
  - 2. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
  - 3. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.
  - 4. See Division 26 individual sections for additional items to include in record drawings.

#### 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations.
- B. Drawings are intended to be diagrammatic and reflect the basis-of-design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e. distribution equipment, duct banks, light fixtures, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis-of-Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- E. UL and CSA Compliance: Provide products which are UL and CSA listed

#### 1.6 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00 and Division 01, Section 26 00 00 and individual Division 26 sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01 and the General Conditions. Confirm requirements in all Contract Documents.

## 1.7 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, lights, cable tray and electrical services with architectural and structural requirements, and other trades (including ceiling suspension and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- C. Verify in field exact size, location, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Provide like items from one manufacturer.

### 2.2 MATERIALS

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL approved or have adequate approval or be acceptable by state, county, and city authorities. Equipment/fixture supplier is responsible for obtaining State, County, and City acceptance on equipment/fixture not UL approved or not listed for installation.
- B. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.
- C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- D. Do not use any materials containing a hazardous substance as defined by EPA, including but not limited to arsenic, lead, asbestos, or volatile organic compound (VOC).

## PART 3 - EXECUTION

### 3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Division 01, Section 26 00 00 and individual Division 26 sections.
- B. Install equipment requiring access (i.e., junction boxes, light fixtures, power supplies, motors, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in passageways, doorways, scuttles or crawlspaces which would impede or block the intended usage.

- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Earthwork:
  - 1. Confirm Earthwork requirements in Contract Documents. In the absence of specific requirements, comply with individual Division 26 sections and the following:
    - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
    - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
    - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Firestopping:
  - 1. Confirm requirements in Division 07. In the absence of specific requirements, comply with individual Division 26 sections and the following:
    - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Plenums:
  - 1. In plenums, provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.
- G. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- H. Provide miscellaneous supports/metals required for installation of equipment and conduit.

### 3.2 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, Section 26 00 00 and individual Division 26 sections.
- B. General:
  - 1. Seismic Design Category: D Soils.
  - 2. Building Category: I, II, III, or IV.
  - 3. Importance Factor (I-p): Equipment importance factor of 1.0.
  - 4. Earthquake resistant designs for Electrical (Division 26) equipment and distribution, i.e. power distribution equipment, generators, UPS, etc. to conform to regulations of jurisdiction having authority.



5. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
  6. Provide stamped shop drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for conduit and equipment. Submit shop drawings along with equipment submittals.
  7. Provide stamped shop drawings from licensed Structural Engineer of seismic flexible joints for conduit crossing building expansion or seismic joints. Submit shop drawings along with seismic bracing details. Coordinate exact design requirements with project Structural Engineer.
- C. Equipment:
1. Provide means to prohibit excessive motion of electrical equipment during earthquake.

### 3.3 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Division 01, Section 26 00 00 and individual Division 26 sections.
- B. Notify Architect and Engineer, in writing, at following stages of construction so that Architect may, at their option, visit site for review and construction observation:
1. Underground conduit installation prior to backfilling.
  2. Prior to covering walls.
  3. Prior to ceiling cover/installation.
  4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
  5. Final Punch:
    - a. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

### 3.4 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00 and Division 01. In the absence of specific requirements in Division 01, comply with individual Division 26 sections and the following:
1. During remodeling or addition to existing structure, while existing structure is occupied, present services to remain intact until new construction, facilities or equipment is installed.
  2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new wiring, and wiring to point of connection.
  3. Coordinate transfer time to new service with Owner. If required, perform transfer during off-peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
    - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
  4. No interruption of services to any part of existing facilities will be permitted without express permission in each instance from Owner. Requests for outages state specific dates and hours and maximum durations, with outages kept to these specific dates and hours and maximum durations. Obtain written permission from Owner for any interruption of power, lighting or signal circuits and systems.
    - a. Organize work to minimize duration of power interruption.
    - b. Coordinate utility service outages with utility company.

### 3.5 CUTTING AND PATCHING

- A. Confirm requirements in Division 00 and Division 01. In the absence of specific requirements in Division 01, comply with individual Division 26 sections and the following:
  - 1. Proposed floor cutting/core drilling/sleeve locations to be approved by project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
  - 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section and will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
  - 3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
  - 4. Restore new or existing work that is cut and/or damaged to original condition. Where alterations disturb lawns, paving, and/or walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
  - 5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

### 3.6 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

### 3.7 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00 and Division 01. In the absence of specific requirements, comply with individual Division 26 sections and the following:
  - 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage and handling to be replaced before installation.
  - 2. Protect equipment to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
  - 3. Protect bus duct and similar items until in service.

### 3.8 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00 and Division 01, Section 26 08 00 and individual Division 26 sections.
- B. Upon completion of work and adjustment of equipment, test systems and demonstrate to Owner's Representative, Architect, and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, Section 26 00 00 and individual Division 26 sections.

- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

### 3.9 CLEANING

- A. Confirm Cleaning requirements in Division 01, Section 26 00 00 and individual Division 26 sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

### 3.10 INSTALLATION

- A. Confirm Installation requirements in Division 00 and Division 01, Section 26 00 00 and individual Division 26 sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- D. Provide miscellaneous supports/metals required for installation of equipment.

### 3.11 DEMOLITION

- A. Confirm requirements in Division 01 and Division 2. In the absence of specific requirements, comply with individual Division 26 sections and the following:
  - 1. It is the intent of these documents to provide necessary information and adjustments to electrical system required to meet code, and accommodate installation of new work.
  - 2. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas. Owner will cooperate to best of their ability to assist in coordinated schedule, but will remain final authority as to time of work permitted.
  - 3. Examination:
    - a. Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.
    - b. Verify that abandoned wiring and equipment serve only abandoned facilities.
    - c. Demolition drawings are based on casual field observation and existing record documents.
      - 1) Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish work.
      - 2) Verify location and number of electrical outlets, luminaires, panels, etc. in field.
    - d. Report discrepancies to Architect before disturbing existing installation.
      - 1) Promptly notify Owner if utilities are found which are not shown on Drawings.
  - 4. Execution:
    - a. Remove existing luminaires, switches, receptacles, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings.

- b. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. Remove or relocate electrical boxes, conduit, wiring, equipment, and luminaires, as encountered in removed or remodeled areas in existing construction affected by this work.
- c. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.
- d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass inaccessible junction boxes and abandoned outlets.
- e. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of construction or demolition and maintain service to existing load.
- f. Extend circuiting and devices in existing walls to be furred out.
- g. Remove abandoned wiring to source of supply.
- h. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- i. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- j. Disconnect and remove abandoned panelboards and distribution equipment.
- k. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- l. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- m. Remove abandoned wiring to leave site clean.
- n. Existing lighting which is to remain, leave luminaires in proper working order.
- o. Repair adjacent construction and finishes damaged during demolition work.
- p. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

### 3.12 ACCEPTANCE

- A. Confirm requirements in Division 00 and Division 01. In the absence of specific requirements, comply with individual Division 26 sections and the following:
  - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
    - a. Cleaning
    - b. Operation and Maintenance Manuals
    - c. Training of Operating Personnel
    - d. Record Drawings
    - e. Warranty and Guaranty Certificates
    - f. Start-up/Test Document and Commissioning Reports

### 3.13 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 01, Section 26 00 00 and individual Division 26 sections.
- B. Tests:
  - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Refer to individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.

2. During site evaluations by Architect or Engineer, provide an electrician with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

### 3.14 SALVAGED EQUIPMENT AND RECYCLED MATERIAL

- A. Salvage the following equipment not being reused and return to Owner:
  1. Luminaires
  2. Panelboards
  3. Breakers
  4. Transformers
  
- B. Electrical equipment that cannot be salvaged for reuse sell/give to recycling company. Recycle following excess, removed, or demolished electrical material:
  1. Copper or aluminum conductors, buses, and motor/transformer windings.
  2. Steel and aluminum from raceways, boxes, enclosures, and housings.
  3. Acrylic and glass from luminaire lenses/refractors.
  
- C. Provide separate on-site storage space for recycled, recycled and salvaged, or salvaged material. Clearly label space as "\_\_\_\_\_".
  
- D. Confirm additional salvaged equipment and recycled materials in the Contract Documents.

END OF SECTION 260000

## SECTION 260501 - ELECTRICAL DEMOLITION

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work Included: Provision of materials, installation and testing of:
  - 1. Materials and Equipment

## 1.2 RELATED SECTIONS

- A. Contents of Division 26 and Division 01, General Requirements apply to this section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00 and Division 01, General Requirements.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00 and Division 01, General Requirements.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00 and Division 01, General Requirements.

## 1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00 and Division 01, General Requirements.

## PART 2 - PRODUCTS

## 2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Determine the exact location of existing utilities and equipment before commencing work, compensate the Owner for damages caused by the failure to locate and preserve utilities. Replace damaged items with new material to match existing.
- C. Verify that abandoned wiring and equipment serve only abandoned facilities.

- D. Demolition drawings are based on casual field observation and existing record documents.
  - 1. Verify the accuracy of the information shown prior to bidding and provide such labor and material as is necessary to accomplish the work.
  - 2. Verify location and number of electrical outlets in the field.
- E. Report discrepancies to Owner before disturbing existing installation.
- F. Report discrepancies to Architect before disturbing existing installation.
- G. Beginning of demolition means installer accepts existing conditions without exception.

### 3.2 PREPARATION

- A. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access, and access to different areas. The Owner will cooperate to the best of their ability to assist in a coordinated schedule, but will remain the final authority as to time of work permitted.
- B. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- C. Coordinate utility service outages with utility company.
- D. Interruption of services (power, telephone, fire alarm, communication systems) to existing facilities: not permitted without express permission in each instance from the Owner.
  - 1. Requests for service outages: state specific dates, hours and the maximum duration.
  - 2. Written permission: obtain from Owner for interruption of power, lighting or signal circuits and systems.
  - 3. Organize the work to minimize duration of service interruptions.
  - 4. Provide temporary wiring and connections to maintain existing systems in service during construction.
- E. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- F. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections.
  - 1. Obtain permission from Owner at least \_\_\_\_\_ working days before partially or completely disabling system.
  - 2. Make temporary connections to maintain service in areas adjacent to work area.
- G. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections.
  - 1. Notify Owner before partially or completely disabling system.
  - 2. Notify local fire service.
  - 3. Make notifications at least \_\_\_\_ working days in advance.
  - 4. Make temporary connections to maintain service in areas adjacent to work area.
- H. Existing Communication Systems: Maintain existing systems in service until new system is complete and ready for service. Disable system only to make switchovers and connections.
  - 1. Notify Owner at least \_\_\_\_ working days before partially or completely disabling system.
  - 2. Notify telephone utility company at least 24 hours before partially or completely disabling system.
  - 3. Make temporary connections to maintain service in areas adjacent to work area.

- I. Existing \_\_\_\_\_ System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections.
  - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
  - 2. Obtain permission from \_\_\_\_\_ at least \_\_\_\_\_ working days before partially or completely disabling system.
  - 3. Make temporary connections to maintain service in areas adjacent to work area.
- J. Overtime and shift work: provide as required to maintain continuity of services during normal working hours of the occupied building.

### 3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- E. Disconnect and remove abandoned panelboards and distribution equipment.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- H. Reroute wiring clear of demolition which serve existing outlets that remain and reconnect back to source.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- K. Furred out walls/columns: extend circuiting and outlets.
- L. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

### 3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires to remain: Remove luminaires for cleaning. Use mild detergent to clean exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.



## 3.5 SALVAGED EQUIPMENT AND RECYCLED MATERIAL

- A. Salvage the following equipment not being reused and return to Owner:
  - 1. Luminaires
  - 2. Panelboards
  - 3. Breakers
  - 4. Transformers
  - 5. Other
  
- B. Salvage the following equipment not being reused and sell/give to electrical salvage company:
  - 1. Luminaires
  - 2. Panelboards
  - 3. Breakers
  - 4. Transformers
  - 5. Other
  
- C. Electrical equipment that cannot be salvaged for reuse sell/give to recycling company. Recycle the following excess, removed, or demolished electrical material:
  - 1. Copper or aluminum conductors, buses, motor/transformer windings, and the like.
  - 2. Steel and aluminum from raceways, boxes, enclosures, housings and the like.
  - 3. Acrylic and glass from luminaire lenses/refractors.
  - 4. Other
  
- D. Provide separate on-site storage space for recycled and salvaged material. Clearly label space as "\_\_\_\_\_".

END OF SECTION 260501

## SECTION 260509 - EQUIPMENT WIRING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work included: Provision of materials, installation and testing of:
  - 1. Equipment connections, whether furnished by Owner or other Divisions of the Contract.

## 1.2 RELATED SECTIONS

- A. Contents of Division 26 and Division 01, General Requirements apply to this section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00 and Division 01, General Requirements.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00 and Division 01, General Requirements.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00 and Division 01, General Requirements apply to this section.

## 1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00 and Division 01, General Requirements.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Materials and equipment for equipment wiring: As specified in individual sections.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Prior to submittal of product data for electrical distribution equipment, obtain and examine product data and shop drawings for equipment furnished by the Owner and by other trades on the project. Update the schedule of equipment electrical connections accordingly, noting proper ratings for overcurrent devices, fuses, safety disconnect switches, conduit and wiring, and the like. As a minimum, this requirement applies to equipment furnished by Owner and equipment furnished under the following divisions of work under this contract:
  - 1. Division 010, Specialties.
  - 2. Division 011, Equipment.
  - 3. Division 014, Conveying Equipment, Vertical Transportation, or \_\_\_\_\_.

4. Division 21, Fire Suppression.
5. Division 22, Plumbing.
6. Division 23, Heating, Ventilating and Air Conditioning.
7. Division \_\_\_\_\_, \_\_\_\_\_.

- B. Unless otherwise noted in Contract Documents, the following voltage and phase characteristics apply to motors:
1. 1/2 HP and Under: 120 volt, 1 phase.
  2. 3/4 HP and Over: 208 volt, 3 phase.
  3. 3/4 HP and Over: 480 volt, 3 phase.

### 3.2 INSTALLATION

- A. Do not install electrical equipment or wiring on mechanical equipment without prior approval of Owner's Representative, Architect, or Engineer.
- B. Provide moisture tight equipment wiring and switches in ducts or plenums used for environmental air.
- C. Connect motor and appliance/utilization equipment complete from panel to motor/equipment as required by code.
- D. Install motor starters and controllers for equipment furnished by others.
- E. Safety Switches: Provide as required by NEC, CEC, or OESC and as directed in Section 26 28 18, Enclosed Switches and Circuit Breakers.
- F. Appliance/Utilization Equipment:
1. Provide appropriate cable and cord cap for final connection unless equipment is provided with same. Provide receptacle configured to receive cord cap.
  2. Verify special purpose outlet NEMA configuration and ampere rating with equipment supplier prior to ordering wiring devices and coverplates.
- G. Freezer and Cooler Boxes:
1. Obtain supplier's shop drawings prior to rough-in and provide complete connections as required by supplier's shop drawings.
  2. Provide wiring and connections to electric defrost elements, door heaters, vent heaters, door switches, lights, condensate drain heaters, blower fans, and control panels.
  3. Provide control wiring as required by control systems and install per manufacturers instructions.
- H. Spray Paint Booth:
- 1.
- I. Kitchen Class 1 Exhaust Hood:
1. Obtain supplier's shop drawings prior to rough-in and provide field wiring and connections per supplier's shop drawings.
  2. Provide wiring and connections to hood lights, fire suppression/extinguishing system, and hood control panel.
  3. Provide interlocks and control wiring to exhaust fan, make-up air unit, solenoid valves, and shunt trip breakers/contactors to deenergize electrical equipment located under hood.
  4. Provide emergency shut-off switches and control wiring per hood suppliers shop drawings.

- J. Refuse/Waste and Recycle Material Compactors:
  - 1. Obtain supplier's shop drawings prior to rough-in and provide complete connections per supplier's shop drawings.
  - 2. Provide connections to control switches, starters, solenoid valves, and blowers.

### 3.3 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Division 01.

### 3.4 SYSTEMS STARTUP

- A. Provide field representative to prepare and start equipment.
  - 1. Test and correct for proper rotation of polyphase motors.
- B. Adjust for proper operation within manufacturer's published tolerances.
- C. Demonstrate proper operation of equipment to Owner's designated representative.

END OF SECTION 260509

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work Included: Provision of materials, installation and testing of:
  - 1. Wires and Cables

## 1.2 RELATED SECTIONS

- A. Contents of Division 26 and Division 01, General Requirements apply to this section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00 and Division 01, General Requirements.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00 and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Cable insulation test reports in project closeout documentation.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00 and Division 01, General Requirements.

## 1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00 and Division 01, General Requirements.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Wires and Cables:
  - 1. Carol
  - 2. General Cable
  - 3. Okonite
  - 4. Southwire
  - 5. Or approved equivalent.

## 2.2 WIRES AND CABLES

- A. Copper, 600 volt rated throughout. Conductors 12AWG and 10AWG, solid. Conductors 8AWG and larger, stranded. 12AWG minimum conductor size. Minimum insulation rating of 90 degrees C. Insulation Type: THWN-2 or XHHW-2.

- B. Aluminum, 600 volt rated throughout. Conductors 4AWG and larger, compact stranded. Aluminum Association 8000(AA-8000) Series alloy conductor material built to ASTM B801 specifications. Connectors and terminations to be those listed by Underwriters Laboratories Standard 486-B and marked "AL7CU" for 60C and 75C rated circuits. Connections and terminations to be installed strictly in accordance with manufacturers recommendations. Alcan/Stabiloy, Nexans/Energex 8000, Southwire or approved equivalent.
- C. Phase color to be consistent at feeder terminations; A-B-C, top to bottom, left to right, front to back.
- D. Color Code Conductors as Follows:

PHASE	208 VOLT WYE	240 VOLT DELTA	480 VOLT
A	Black	Black	Brown
B	Red	Orange (High Leg)	Orange
C	Blue	Blue	Yellow
Neutral	White	White	Gray or White w/colored strip
Ground	Green	Green	Green
Isolated Ground	Green w/yellow trace	N/A	N/A

- E. MC Cable: High strength galvanized steel or aluminum flexible armor. Full length minimum size No. 12 copper ground wire, THHN 90C conductors, full length tape marker phase/circuit identification on cable armor. Overall green finish on HCF-MC type cable. Short circuit throat insulators, mechanical compression termination.
- F. NMB Cable: Annealed copper conductors, 600 volt rated. Minimum Size No. 12 or 14 with ground wire. 90C rated, PVC or nylon jacketed insulation.
- G. SO Cord: Annealed copper conductors, 600 volt rated. Minimum size No. 12 AWG with ground wire. Maximum of six conductors and ground per cable. 90 degrees C rated thermoset jacket.
- H. Service Entrance Cable: Copper conductor, 600 volt insulation, XHHW, Type SE.
- I. Armored Cable: Continuous corrugated aluminum armor, black or green PVC jacket, with grounding conductor, XHHW-2 90 degrees C conductors, full length tape marker on jacket.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Wires and Cables:
1. Conductor Installation:
    - a. Install conductors in raceways having adequate, code size cross-sectional area for wires indicated.
    - b. Install conductors with care to avoid damage to insulation.
    - c. Do not apply greater tension on conductors than recommended by manufacturer during installation.
    - d. Use of pulling compounds is permitted. Clean residue from exposed conductors and raceway entrances after conductor installation. Do not use pulling compounds for installation of conductors connected to GFCI circuit breakers or GFCI receptacles.
    - e. Do not use aluminum wire to make connections to mechanical equipment.

2. Aluminum Conductor Splices, Joints and Terminations: Join conductors using compression splice barrels or bolted compression lugs. Terminate conductors using compression lugs. Apply number of compression indents as directed by the manufacturer instructions.
3. Conductor Size and Quantity:
  - a. Install no conductors smaller than 12AWG unless otherwise shown.
  - b. Provide required conductors for a fully operable system.
4. Provide dedicated neutrals (one neutral conductor for each phase conductor) in the following single phase circuits:
  - a. Multi-conductor branch circuits fed from single-pole overcurrent protective devices.
  - b. Dimmer controlled circuits.
  - c. Isolated ground circuits.
  - d. Ground fault protected circuits where a GFCI breaker is used in a panelboard.
  - e. Other electronic equipment which produces a high level of harmonic distortion including, but not limited to, computers, printers, plotters, copy machines, and fax machines.
5. Conductors in Cabinets:
  - a. Cable and tree wires in panels and cabinets for power and control. Use plastic ties in panels and cabinets.
  - b. Tie and bundle feeder conductors in wireways of panelboards.
  - c. Hold conductors away from sharp metal edges.
6. Use of MC/AC Cable is limited to the following conditions. Installations that do not comply with the following conditions are to be removed and replaced with no additional expense to the Owner.
  - a. 20 and 30 amp branch wiring where following conditions apply:
    - 1) Where there is a suspended ceiling with accessible space above (example: suspended acoustic ceiling tile).
    - 2) For drops to ceiling mounted luminaires in areas with accessible ceiling space.
    - 3) In residential units.
    - 4) Do not use for homeruns from branch circuit panel to first device or luminaire in circuit.
    - 5) Do not use in walls in areas where MC cable cannot be fished into the walls after construction is completed. For example: walls with glazing or solid beams overhead, partial height walls, etc.
    - 6) No single run of MC/AC cable longer than 50-feet.
7. NMB cable allowed only in the following locations:
  - a. Location
8. Exposed cable is not allowed or allowed in the following locations.
  - a. Location
  - b. Location
  - c. Location
9. Exposed cable must be run parallel or perpendicular to building lines and hidden from view when possible.

### 3.2 FIELD QUALITY CONTROL

#### A. Tests:

1. Test conductor insulation on feeders of 100 or \_\_\_\_\_ amp and greater for conformity with 1000 volt megohmmeter. Use Insulated Cable Engineers Association testing procedures. Minimum insulation resistance acceptable is 1 megohm for systems 600 volts and below. Notify Architect if insulation resistance is less than 1 megohm.
2. Test Report: Prepare a typed tabular report indicating the testing instrument, the feeder tested, amperage rating of the feeder, insulation type, voltage, the approximate length of the feeder, conduit type, and the measured resistance of the megohmmeter test. Submit report with operating and maintenance manual.

END OF SECTION 260519

## SECTION 260533 - RACEWAYS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work included: Provision of materials, installation and testing of:
  - 1. Rigid Metal Conduit (RMC)
  - 2. Intermediate Metal Conduit (IMC)
- B. Provide a complete system of conduit and fittings, with associated couplings, connectors, and fittings, as shown on drawings and described in these specifications.
- C. Basis-of-Design: Surface raceway design, shown on the drawings, is based on Wiremold, Panduit, or \_\_\_\_\_ product line. Approved manufacturers listed below are allowed on condition of meeting the specified conditions including area of fill, finish and coordination with other trades. Remove and replace raceway not meeting these conditions at no cost to Owner.

## 1.2 RELATED SECTIONS

- A. Contents of Division 26 and Division 01, General Requirements apply to this section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00 and Division 01, General Requirements.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00 and Division 01, General Requirements.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00 and Division 01, General Requirements.

## 1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00 and Division 01, General Requirements.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Rigid Metal Conduit (RMC):
  - 1. Allied Tube & Conduit
  - 2. Beck Manufacturing Inc.
  - 3. Picoma
  - 4. Wheatland Tube Company
  - 5. Or approved equivalent.



- B. Intermediate Metal Conduit (IMC):
  1. Allied Tube & Conduit
  2. Beck Manufacturing WL
  3. Picoma
  4. Wheatland Tube Company
  5. Or approved equivalent.

## 2.2 RIGID METAL CONDUIT (RMC)

- A. UL 6, ANSI C80.1. Hot dipped galvanized steel conduit after thread cutting.
  1. Fittings: NEMA FB2.10.

## 2.3 INTERMEDIATE METAL CONDUIT (IMC)

- A. UL6, ANSI C80.6. Hot dipped galvanized after thread cutting.
  1. Fittings: NEMA FB2.10.

## PART 3 - EXECUTION

### 3.1 SEQUENCING AND SCHEDULING

- A. Raceway system is defined as consisting of conduit, tubing, duct, and fittings including but not limited to connectors, couplings, offsets, elbows, bushings, expansion/deflection fittings, and other components and accessories. Complete electrical raceway installation before starting the installation of conductors and cables.
- B. Finished Surfaces: Schedule raceway installation to avoid conflict with installed wall and ceiling surfaces. If unavoidable, coordinate work and repairs with Architect.

### 3.2 CONDUIT REQUIREMENTS

- A. Conduit Size:
  1. Minimum Size: 1/2-inch or 3/4-inch for power and control, unless otherwise noted. 3/4-inch for communication/data, unless otherwise noted. 1/2-inch for signal systems, unless otherwise noted.
- B. Underground Installations:
  1. More than 5-feet or \_\_\_\_\_ feet from Foundation Wall: Use RMC, IMC, or PVC
  2. Within 5-feet or \_\_\_\_\_ feet from Foundation Wall: Use RMC, IMC, or PVC
  3. In or Under Slab on Grade: Use RMC, IMC, or PVC
  4. Minimum Size: 1-inch.
  5. Emergency System (Life Safety and Critical) per NEC 517.30(c)(1): Schedule 80 PVC.
- C. Outdoor Locations Above Grade: Use RMC or IMC
- D. In Slab Above Grade:
  1. Use RMC, IMC, or PVC
  2. Maximum Size Conduit in Slab: Contact Structural Engineer for maximum outside diameter of conduit.
- E. Damp Locations: RMC, IMC, or EMT up to 2-inches in diameter.

- F. Dry Locations:
  1. Concealed: Use RMC, IMC, or EMT
  2. Exposed: Use RMC, IMC, or EMT
- G. Dry, Protected: RMC, IMC, or EMT
- H. In areas exposed to severe mechanical damage: RMC.
- I. For security conduits installed exposed and subject to tampering: RMC.
- J. In hazardous areas per CEC 501 or NEC 501: RMC or IMC.
- K. Provide two pull strings/tapes in empty conduits. Types:
  1. Utility Co. conduit: Polyester measure/pulling tape, Greenlee 4436 or approved equivalent. Coordinate exact requirements with Utility Co.
  2. Feeders: Polyester measure/pulling tape, Greenlee 4436 or approved.
  3. Branch circuits and low voltage: Greenlee Poly Line 431 or approved.
  4. If fish tape is used for pulling line or low voltage wiring, fiberglass type to be used. Metal fish tapes will not be allowed.
  5. Secure pull string/tape at each end.
  6. Provide caps on ends of empty conduit to be used in future.
- L. Elbow for Low Energy Signal Systems: Use long radius factory ells where linking sections of raceway for installation of signal cable.
- M. For Dry Areas: Motors, recessed luminaires and equipment connections subject to movement or vibration, use flexible metallic conduit.
- N. Motors and equipment connections subject to movement or vibration and subjected to any of following conditions; exterior location, moist or humid atmosphere, water spray, oil, or grease use PVC coated liquidtight flexible metallic conduit.

### 3.3 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Plan locations of conduit runs in advance of the installation and coordinate with ductwork, plumbing, ceiling and wall construction in the same areas.
- C. Locate penetrations and holes in advance where they are proposed in the structural sections such as footings, beams, and walls. Penetrations are acceptable only when the following occurs:
  1. Where shown on the structural drawings.
  2. As approved by the Structural Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
- D. Verify routing and termination locations of conduit prior to rough-in.
- E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

## 3.4 INSTALLATION

- A. Install conduit securely, in neat and workmanlike manner, as specified in NECA 1.
- B. Install steel conduit as specified in NECA 101.
- C. Install nonmetallic conduit in accordance with manufacturer's instructions.
- D. Inserts, anchors and sleeves.
  - 1. Coordinate location of inserts and anchor bolts for electrical systems prior to concrete pour.
  - 2. Coordinate location of sleeves with consideration for other building systems prior to concrete pour.
- E. Conduit Supports:
  - 1. Arrange supports to prevent misalignment during wiring installation.
  - 2. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
  - 3. Group related conduits; support using conduit rack. Construct rack using steel channel. Provide space on each for 25 percent additional conduits.
  - 4. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
  - 5. Do not attach conduit to ceiling support wires.
- F. Flexible steel conduit length not-to-exceed 6-feet, 3-feet in concealed walls. Provide sufficient slack to reduce the effect of vibration.
- G. Install conduit seals at boundaries where ambient temperatures differ by 10 degrees F or more as shown on the drawings. Install seals on warm side of partition.
- H. Keep conduits a minimum of 12-inches away from steam or hot water radiant heating lines (at or above 104 degrees F) or 3-inches away from waste or water lines.
- I. Seal raceways stubbing up into electrical equipment. Plug raceways with conductors with duct-seal. Cap spare raceways and plug PVC raceway products with plastic plugs as made by Underground Products, or equal, shaped to fit snugly into the stubup.
- J. Seal raceways penetrating an exterior building wall to prevent moisture and vermin from entering into the electrical equipment.
- K. Only conduit servicing elevator equipment can be installed through elevator shafts or equipment rooms. These conduits may only enter the room and go directly to the equipment being supplied.
- L. Keep 277/480 volt wiring independent of 120/208 volt wiring, and power wiring. Keep power wiring independent of communication system wiring. Keep emergency system wiring independent of other wiring systems.
- M. Keep life safety, critical branch and equipment systems wiring independent of other systems.
- N. Use suitable caps on spare and empty conduits to protect installed conduit against entrance of dirt and moisture.
- O. Installation of conduit in structural concrete that is less than 3-inches thick is prohibited without the approval of the Structural Engineer. Maintenance pads, and curbs are exempted.

- P. Raceways Embedded in Floor Slabs:
1. Do not install raceways in slab without the approval of the Structural Engineer.
  2. Do not let raceways interfere with placement of floor slab reinforcement components.
  3. Install raceways between the upper and the lower layers of reinforcing steel.
  4. Space raceways not less than 8-inches on centers except where they converge at panels or junction boxes.
  5. Raceways running parallel to slabs supports, such as beams, columns and structural walls, to be installed not less than 12-inches from such supporting elements.
  6. Branch circuit homeruns are not permitted in slab, route branch circuit homeruns above grade exposed in approved areas or above lay-in ceiling spaces.
  7. Route conduits in or under slabs point-to-point.
  8. Do not cross conduits in slab.
  9. Encase medium voltage feeder conduits using red concrete.
- Q. Conduit Joints: Assemble conduits continuous and secure to boxes, panels, luminaires and equipment with fittings to maintain continuity. Provide watertight joints where embedded in concrete, below grade or in damp locations. Seal PVC conduit joints with solvent cement and metal conduit with metal thread primer. Rigid conduit connections to be threaded, clean and tight (metal to metal). Threadless connections are not permitted for RMC and IMC. Seal conduits where penetrating below raised floor area.
- R. Arrange conduit to maintain headroom and present neat appearance.
- S. Do not install conduits on surface of building exterior, across roof, on top of parapet walls, or across floors, unless otherwise noted on drawings.
- T. Exposed conduits are permitted only in following areas:
1. Mechanical rooms, electrical rooms or spaces where walls, ceilings and floors will not be covered with finished material.
  2. Existing walls that are concrete or block construction.
  3. Where specifically noted on Drawings.
  4. Route exposed conduit parallel and perpendicular to walls, tight to finished surfaces and neatly offset into boxes.
- U. Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block area passage's intended usage.
- V. Install continuous conduit and raceways for electrical power wiring and signal systems wiring.
- W. Below Grade Conduit and Cables:
1. Place minimum 3-inch cover of sand or clean earth fill around cable or conduit on leveled trench bottom. Lay conduit on smooth level trench bottom, so that contact is made for its entire length.
  2. Remove water from trench before electrical conduit is installed.
  3. When three or more conduits are in single trench, use conduit spacers that will maintain 3-inch spacing between conduits. Provide spacers on 5 foot centers.
  4. Refer to trench detail on drawings.
  5. Elbows larger than 30 degrees or 1-inch diameter will be PVC coated galvanized rigid conduit.
  6. Provide trenching, backfilling, compaction, re-paving or other site restoration as required by work done in this division.
  7. Slope underground conduits which enter building to drain away from building and to be water sealed to prevent moisture from passing through conduit into building. Joints threaded and taped or glued to prevent entry of water into conduits.

8. Install underground conduits entering building as poured-in-place, or else provide watertight conduit sleeves and rubber seals, Link-seal system by Thunderline Corporation or equivalent.
- X. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- Y. Do not cross conduits in slab.
- Z. Maintain adequate clearance between conduit and piping.
- AA. Maintain 6-inch clearance between conduit and surfaces with temperatures exceeding 120 degrees F.
- AB. Cut conduit square using saw or pipecutter; de-burr cut ends.
- AC. Bring conduit to shoulder of fittings; fasten securely.
- AD. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- AE. Use conduit hubs, sealing locknuts, or \_\_\_\_\_ to fasten conduit to cast boxes in damp and wet locations.
- AF. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one shot bender to fabricate bends in metal conduit larger than 2 inch (50 mm) size.
- AG. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- AH. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, expansion joints, and \_\_\_\_\_.
- AI. Conduit Terminations for Signal Systems: Provide a plastic bushing on the end of conduit used for signal system wiring.
- AJ. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- AK. Flexible Conduit: Install 12-inch minimum slack loop on flexible metallic conduit and liquidtight flexible metallic conduit.
- AL. Branch Circuits: Do not change intent of branch circuit or controls without approval. Homeruns for 20 amp branch circuits may be combined to maximum of six conductors in homerun. Apply derating factors. Increase conductor size as needed.
- AM. Feeders: Do not combine or change feeder runs.
- AN. Install conduits in above grade slabs located in middle of slab maximum size. Spacing and location of conduits in post-tension slabs is subject to approval by Structural Engineer.

### 3.5 CONDUIT FITTINGS

- A. Use set screw type fittings only in dry locations. When set screw fittings are utilized provide insulated continuous equipment ground conductor in conduit, from overcurrent protection device to outlet.

- B. Use compression fittings in dry locations, damp and rain-exposed locations. Maximum size permitted in damp locations and locations exposed to rain is 2-inches in diameter.
  - C. Use threaded type fittings in wet locations, hazardous locations, and damp or rain-exposed locations where conduit size is greater than 2-inches.
  - D. Use PVC coated RMC 36-inch radius ells for power service conduits and 48-inch radius ells for telephone service conduits.
  - E. Use insulated type bushings with ground provision at switchboards, panelboards, safety disconnect switches, junction boxes that have feeders 60 amperes and greater.
  - F. Condulets and Conduit Bodies:
    - 1. Do not use condulets and conduit bodies in conduits for signal wiring or in feeders 100 amp and larger.
    - 2. Do not use condulets and conduit bodies.
  - G. Sleeves and Chases - Floor, Ceiling and Wall Penetrations: Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceilings or walls.
  - H. Expansion Joints:
    - 1. Provide conduits crossing expansion joints where cast in concrete with expansion-deflection fittings, equivalent to OZ/Gedney AXDX, installed per manufacturers recommendations.
    - 2. Secure conduits 3-inches and larger to building structure on opposite sides of a building expansion joint with an expansion-deflection fitting across joint, equivalent to OZ/Gedney AXDX, installed per manufacturer's recommendations.
    - 3. Provide conduits less than 3-inches where not cast in concrete with junction boxes securely fastened on both sides of expansion joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits 3-inch and larger may be installed.
  - I. Seismic Joints:
    - 1. No conduits cast in concrete allowed to cross seismic joint.
    - 2. Provide conduits with junction boxes securely fastened on both sides of seismic joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. Prior to installation, verify with Architect that 15-inches is adequate for designed movement, and if not, increase this length as required.
  - J. Provide rigid conduit coupling flush with surface of slab or wall for conduit stubbed in concrete slab or wall to serve electrical equipment or an outlet under table or to supply shop tool, etc. Provide plug where conduit is to be used in future.
- 3.6 ELECTRICAL NONMETALLIC TUBING (ENT)
- A. Install where allowed by NEC Article 362 and where not restricted in these specifications.
  - B. Support horizontal and vertical tubing 3-feet on center (maximum) and within 6-inches of boxes and approved cable clamps.
  - C. Support tubing above ceilings; do not rest tubing on ceiling. Attach tubing with approved metal clips or plastic cable ties to support tubing from structure on 3 foot centers maximum.

- D. Cut tubing with manufacturer approved devices. Trim cut edges inside and outside to remove rough edges
- E. Splice conductors in accessible junction boxes.
- F. Support tubing independently from supports for mechanical ducts, water, sprinkler or gas piping; maintain 6-inch separation minimum from surfaces that are hotter than 25C.
- G. Provide junction box at tubing penetrations of wall, ceiling or floor surfaces for equipment connections; tubing not to be run directly through finishes surfaces.
- H. Provide bushing to protect wire from abrasion where tubing enters box, fitting, or other enclosure.
- I. Provide separate code sized equipment grounding conductor in ENT.
- J. Provide junction box at transition from concealed to exposed tubing.

### 3.7 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 7.
- B. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation and installer.

### 3.8 SURFACE METAL RACEWAY SYSTEM

- A. Install per manufacturer's installation instructions, perpendicular and parallel to building lines.
- B. Sleeves and Chases - Floor, Ceiling and Wall Penetrations: Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceiling or walls.
- C. Install raceways securely, in a neat manner with good workmanship, as specified in NECA 1.
- D. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.
- E. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- F. Close end of wireway and unused conduit openings.

END OF SECTION 260533

## SECTION 262800 - OVERCURRENT PROTECTIVE DEVICES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Work Included: Provision of materials, installation and testing of:
  - 1. Molded Case Circuit Breakers

## 1.2 RELATED SECTIONS

- A. Contents of Division 26 and Division 01, General Requirements apply to this section.

## 1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00 and Division 01, General Requirements.

## 1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00 and Division 01, General Requirements.
- B. In addition, provide:
  - 1. Product data and instantaneous let-through current curves and average melting time current curves for fuses supplied to project.
  - 2. Product data and time/current trip curves for circuit breakers supplied to project.

## 1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00 and Division 01, General Requirements apply to this section.

## 1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00 and Division 01, General Requirements.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Circuit Breakers:
  - 1. Eaton Electrical
  - 2. General Electric
  - 3. Siemens
  - 4. Square D
  - 5. Or approved equivalent.

## 2.2 MOLDED CASE CIRCUIT BREAKERS

- A. 1-, 2- or 3-pole bolt-on, single handle common trip, 600VAC or 250VAC as indicated on Drawings.



- B. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
- C. Calibrate for operation in 40C ambient temperature.
- D. 15 to 150 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.
- E. 151 to 400 Amp Breakers: Variable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.
- F. Greater than 401 Amp: Electronic trip type with adjustments for long-time, instantaneous, and short-time functions.
- G. Provide ground fault function for breakers greater than 800 amps where applied at 480 volts line-to-line; and where indicated on drawings.

### PART 3 - EXECUTION

#### 3.1 COORDINATION

- A. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.
- B. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to overcurrent protective devices as necessary to coordinate with the nameplate rating.

#### 3.2 INSTALLATION

- A. Fuses: For each class and ampere rating of fuse installed, provide the following quantities of spares for quantity of fuses installed:
  - 1. 0 to 24: Provide 6 spare.
  - 2. 25 to 48: Provide 9 spare.
  - 3. 49 and Above: Provide 12 spare.
- B. Provide testing of ground fault interrupting breakers.
- C. Circuit Breakers:
  - 1. Provide circuit breakers, as specified and on Drawings, for installation in panelboards, individual enclosures or combination motor starters.
  - 2. Provide ground fault interrupter circuit breakers for equipment in damp or wet locations.
  - 3. Provide device on handle to lock breaker in "ON" position for breakers feeding time switches, night lights and similar circuits required to be continuously energized.
  - 4. Provide multi-pole branch circuit breakers for multiwire branch circuits for simultaneous disconnection of circuits.

END OF SECTION 262800