

**THE NAVAJO NATION  
HOSPITALITY ENTERPRISE  
WINDOW ROCK OFFICE  
BUILDING & SITE**

**PROJECT MANUAL**

**DECEMBER 2019**

TABLE OF CONTENTS

DIVISION 1 - GENERAL REQUIREMENTS

011000 Summary  
012600 Contract Modification Procedures  
012900 Payment Procedures  
013100 Project Management and Coordination  
013200 Construction Progress Documentation  
013300 Submittal Procedures  
014000 Quality Requirements  
014200 References  
015000 Temporary Facilities and Controls  
016000 Product Requirements  
017300 Execution Requirements  
017329 Cutting and Patching  
017419 Construction Waste Management  
017700 Closeout Procedures  
017823 Operation and Maintenance Data  
017839 Project Record Documents  
017900 Demonstration and Training

DIVISION 3 - CONCRETE

033000 Cast-In-Place Concrete

DIVISION 4 – MASONRY

047300 Manufactured Masonry Veneer

DIVISION 5 – METALS

051200 Structural Steel  
055000 Metal Fabrications

DIVISION 6 - WOOD AND PLASTICS

061000 Rough Carpentry  
061053 Miscellaneous Rough Carpentry  
061600 Sheathing  
064023 Interior Architectural Woodwork  
068200 Fiber Reinforced Plastic (FRP) Panels

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

071910 Concrete Floor Sealer  
072419 Exterior Insulation and Finish System  
075423 Thermoplastic Polyolefin (TPO) Roofing  
076200 Sheet Metal Flashing and Trim  
076500 Flexible Sheet Flashing  
077200 Roof Accessories  
077233 Roof Hatches  
079200 Joint Sealants

Window Rock Office Building and Site  
Construction Documents

DIVISION 8 - DOORS AND WINDOWS

081113 Steel Doors and Frames  
081416 Flush Wood Doors  
087100 Door Hardware  
088000 Glazing

DIVISION 9 – FINISHES

092900 Gypsum Board  
093000 Tiling  
095100 Acoustical Panel Ceilings  
096513 Resilient Wall Base and Accessories  
096800 Carpeting  
099100 Painting

DIVISION 10 – SPECIALTIES

101400 Signage  
102600 Wall and Door Protection  
102800 Toilet and Bath Accessories  
104400 Fire Protection Specialties

DIVISION 16 – ELECTRICAL

160500 Common Work Results For Electrical  
160600 Grounding and Bonding  
162890 Surge Protection Devices  
164100 Enclosed Switches and Breakers  
167730 Vibration and Seismic Requirements for Electrical Systems

DIVISION 22 PLUMBING

220500 Common Work Results for Plumbing  
220513 Common Motor Requirements for Plumbing Equipment  
220517 Sleeves and Sleeve Seals for Plumbing Piping  
220518 Escutcheons for Plumbing Piping  
220523 General-Duty Valves for Plumbing Piping  
220529 Hangers and Supports for Plumbing Piping and Equipment  
220548 Vibration and Seismic Controls for Plumbing Piping and Equipment  
220553 Identification for Plumbing Pipes and Equipment  
220700 Plumbing Insulation  
221116 Domestic Water Piping  
221119 Domestic Water Piping Specialties  
221316 Sanitary Waste and Vent Piping  
221320 Sanitary Waste Piping Specialties  
223100 Domestic Water Softeners  
223300 Electric Domestic Water Heaters  
224000 Plumbing Fixtures  
224700 Drinking Fountains and Water Coolers

DIVISION 23 HEATING VENTILATING AND AIR CONDITIONING

230100 Mechanical Requirements  
230150 Temporary Use of Equipment and Systems  
230500 Common Work Results for HVAC

Window Rock Office Building and Site  
Construction Documents

230513 Common Motor Requirements for HVAC Equipment  
230514 Variable Frequency Motor Drives  
230523 General Piping Valves for HVAC Piping  
230529 Hangers and Supports  
230548 Vibration Isolation and Seismic Restraints  
230550 Operations and Maintenance Manuals  
230553 Identification for Piping & Equipment  
230594 General Testing, Adjusting, Balancing and Commissioning  
230713 Duct Insulation  
230720 Pipe Insulation  
230993 Sequences of Operation  
233001 Common Duct Requirements  
233113 Metal Ducts  
233300 Air Duct Accessories  
233423 Power Ventilators  
233713 Diffusers, Registers, and Grilles  
238143 Heat Pumps

DIVISION 31 EARTHWORK

310000 Earthwork  
311100 Clearing and Grubbing  
312317 Trenching

DIVISION 32 - EXTERIOR IMPROVEMENTS

320113 Slurry Seal  
320117 Pavement Crack Seal  
321123 Aggregate Base Course  
321203 Paving Asphalts  
321213 Prime Coat  
321214 Tack Coat  
321216 Asphalt Paving  
321313 Concrete Paving  
321723 Pavement Marking

DIVISION 33 - UTILITIES

331100 Water Utility Distribution  
331216 Valves  
333100 Sanitary Utility Sewerage Utilities

Otis Elevator Specification

END OF TABLE OF CONTENTS

## SECTION 011000 - SUMMARY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Work covered by the Contract Documents.
  - 2. Type of the Contract.
  - 3. Work phases.
  - 4. Use of premises.
  - 5. Work restrictions.
  - 6. Specification formats and conventions.
  - 7. Deferred Approvals.
  - 8. Pollution Control.
  - 9. Storm Water Pollution Prevention Plan.
- B. Related Sections include the following:
  - 1. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

#### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Window Rock Office Building & Site
  - 1. Project Location: Window Rock, Arizona
- B. Owner: The Navajo Nation Hospitality Enterprise
- C. Architect: Iron Rock Engineering
- D. The Work consists of the following:
  - 1. Office Building:  
The proposed Window Rock Office Building consists of a three story, 15,000 square foot (5,000 square foot building footprint) office building of wood frame construction on a concrete slab on grade type foundation. The roof and upper floors for the building are to be constructed with prefabricated wood trusses.
  - 2. Building Site:  
The site work will entail preparation of the site including grading, utilities, parking lot, and other site improvements as detailed on the construction drawings for the proposed three story office building.

#### 1.4 TYPE OF CONTRACT

- A. Project will be constructed under a single prime contract

1.5 WORK PHASES

- A. The Work shall be conducted in single phase.

1.6 USE OF PREMISES

- A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.
- B. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Owner Occupancy: Allow for Owner occupancy of Project site and use by the public.
  2. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.7 WORK RESTRICTIONS

- A. On-Site Work Hours:
1. 7 a.m. to 7 p.m., Monday through Friday, except otherwise indicated.

1.8 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 49-division format and CSI's MasterFormat 2004 numbering system.
1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
  2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
  - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

#### 1.9 DEFERRED APPROVALS

- A. Deferred approval items are listed on Drawings.
- B. Contractor is solely responsible for obtaining all necessary approvals and all costs associated with obtaining the approval of Agency Having Jurisdiction (AHJ) including all Architectural and Engineering fees for coordinating with Agency Having Jurisdiction (AHJ) beyond review and shipping of two separate Contractor provided submittals. Do not commence installation of any deferred approval item until all approvals have been obtained.
- C. Deferred Approvals. Only where a portion of the construction cannot be adequately detailed on the approved plans because of variations in product design and/or manufacturer, the approval of plans for such portion, when specifically accepted by Agency Having Jurisdiction (AHJ), may be deferred until the material suppliers are selected provided the following conditions are met:
  1. The project plans clearly indicate that a deferred approval by Agency Having Jurisdiction (AHJ) is required for the indicated portions of the work prior to fabrication and installation.
  2. The project plans and specifications adequately describe the performance and loading criteria for such work.
  3. An architect or registered engineer stamps and signs the plans and specifications for the deferred approval item. The architect or engineer in general responsible charge of the design of the project shall submit the plans and specifications for the deferred approval item to the enforcement agency, with notation indicating that the deferred approval documents have been found to be in general conformance with the design of the building.
  4. Fabrication of deferred approval items shall not begin with out first obtaining the approval of plans and specifications by Agency Having Jurisdiction (AHJ).
- D. Deferred Approval Submittals, General:
  1. Submit initial deferred approval submittal to Architect within 35 calendar days from the date of issuance of Notice to Proceed, and before any materials are delivered to the jobsite. Contractor is solely responsible for obtaining all necessary approvals. Do not commence installation of any deferred approval item until all approvals have been obtained.
  2. Product Data: Product data: Submit manufacturer's specifications and certified test reports made by an independent testing organization for each type and class of material to show compliance with code requirements and gain approval of Agency Having Jurisdiction (AHJ).

3. Shop Drawings: Submit complete shop drawings including dimensioned plans, elevations, and all details of typical sections and connections. Shop drawings shall show design loads and all details of the installation. Title sheet of shop drawings shall list testing requirements and shall state that licensed engineer shall review and certify the completed installation is in accordance with the approved shop drawings. Shop drawings shall be stamped, dated and signed by professional engineer licensed in the State of Utah as evidence of his or her responsibility for the work.
4. Shop drawings:
  - a. Format: 24" x 36" sheet format with border and title block identifying, at a minimum, the project name, project number, project location, date, contractor and structural engineer of record.
  - b. 1 set of reproducible shop drawings each submittal review.
  - c. 1 set of reproducible shop drawings for each plan check review.
  - d. 1 set of reproducible mylars of shop drawings approved by Agency Having Jurisdiction (AHJ).
5. Calculations: Submit calculations prepared by a professional engineer licensed in the State of Utah. Engineer shall sign, date and stamp calculations as evidence of his or her responsibility for the work.
6. Submittals shall be approved first by the Architect, then by the Agency Having Jurisdiction (AHJ).
7. See additional requirements in Division 1 Section "Submittal Procedures".

#### 1.10 POLLUTION CONTROL

- A. Provide positive methods, means and facilities required to prevent contamination of the soil, water or atmosphere by the discharge of noxious substances from the construction operations.

#### 1.11 STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

- A. The contractor shall submit a Storm Water Pollution Prevention Plan for approval by Owner and Architect if required. The plan shall show erosion control measures and indicate locations of staging, fueling, equipment and employee parking, and storage/stockpile locations. Locations for concrete washout shall be shown, as well as gravel site entrances and/or metal grates to keep soil from being deposited on City streets. The plan shall note that street sweeping shall occur as often as necessary, to ensure that no dirt or dust will remain on City streets. The truck haul routes and equipment staging areas shall be located at the south side of the construction site, per Mitigation Measure N-7. Drip pans shall be used under parked equipment and visqueen shall be shown on the plan to protect the soil in the fueling area. Only minor vehicle maintenance shall occur on-site. Maintenance shall occur in the fueling area and soil shall be protected by drip pans and visqueen.
- B. Contractor shall provide Best Management Practice (BMP) methods and controls for wet weather grading activities and erosion control for both onsite and offsite improvements, in accordance with the requirements of the NPDES General Permit for Storm Water Discharges Associated with Construction Activity.

#### 1.12 MISCELLANEOUS PROVISIONS



- A. General: Comply with the Project Conditions of Approval for both noise and dust control. If there is any conflict between drawings and specifications and the Project Conditions of Approval regarding noise and dust control, the Project Conditions of Approval shall govern.
- B. Dust Control. The Contractor shall be fully and solely responsible for maintaining and upkeeping all areas of the Site and adjoining areas, outdoors and indoors, free from flying debris, grinding powder, sawdust, dirt and dust as well as any other product, product waste or work waste, that by becoming airborne may cause respiratory inconveniences to persons, particularly to students and Owner's personnel. Additionally, the Contractor shall take specific care to avoid deposits of airborne dust or airborne elements. Such protection devices, systems or methods shall be in accordance with the regulations set forth by the EPA and OSHA, and other applicable law, rule or regulation. Additionally, the Contractor shall be the sole party responsible to regularly and routinely clean up and remove any and all deposits of dust and other elements. Damage and/or any liability derived from the Contractor's failure to comply with these requirements shall be exclusively at the cost of the Contractor, including, without limitation, any and all penalties that may be incurred for violations of applicable law, rule or regulation, and any amounts expended by the Owner to pay such damages shall be due and payable to the Owner on demand. Contractor shall replace any damages property or part thereof and professionally clean any and all items that become covered or partially covered to any degree by dust or other airborne elements. If classes are in session at any point during the progress of Work, and, in the Owner's reasonable discretion, flying debris, grinding powder, sawdust, dirt or dust from any Work disrupts or disturbs the students or faculty or the normal operation of the college, at the Owner's request, the Contractor shall schedule the performance of all such Work around normal college hours and make other arrangements so that the Work does not cause such disruption or disturbance. In no event shall such arrangements result in adjustment of the Contract Price or the Contract Time.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

## SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

### 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 specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
  - 1. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

#### 1.3 MINOR CHANGES IN THE WORK

- A. Architect may issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions" or an equivalent form acceptable to.

#### 1.4 PROPOSAL REQUESTS (BULLETIN)

- A. Owner-Initiated Proposal Requests: Architect may issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Proposal Requests issued are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect may issue a Change Order for signatures of Owner and Contractor.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

## SECTION 012900 - PAYMENT PROCEDURES

### 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 specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
  - 1. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 2. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

#### 1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

#### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
  - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with Continuation Sheets.
    - b. Submittals Schedule.
    - c. Contractor's Construction Schedule.
  - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than 7 days before the date scheduled for submittal of initial Applications for Payment.
  - 3. No payment applications will be signed by the Architect prior to the Contractor submitting, and the Architect reviewing, a schedule of values.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the Schedule of Values:

Window Rock Office Building and Site  
Construction Documents

- a. Project name and location.
  - b. Name of Architect.
  - c. Architect's project number.
  - d. Contractor's name and address.
  - e. Date of submittal.
2. Submit draft of AIA Document G703 Continuation Sheets.
  3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
    - a. Related Specification Section or Division.
    - b. Description of the Work.
    - c. Name of subcontractor.
    - d. Name of manufacturer or fabricator.
    - e. Name of supplier.
    - f. Change Orders (numbers) that affect value.
    - g. Dollar value.
      - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
  4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
  5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
  6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    - a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
  7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
  8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
    - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
  9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

#### 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
  1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times:
  1. The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

## Window Rock Office Building and Site

### Construction Documents

- C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
  - 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
  - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
  - 1. List of subcontractors.
  - 2. Schedule of Values.
  - 3. Contractor's Construction Schedule (preliminary if not final).
  - 4. Products list.
  - 5. Schedule of unit prices.
  - 6. Submittals Schedule (preliminary if not final).
  - 7. List of Contractor's staff assignments.
  - 8. List of Contractor's principal consultants.
  - 9. Copies of building permits.
  - 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  - 11. Initial progress report.
  - 12. Report of preconstruction conference.
  - 13. Certificates of insurance and insurance policies.
  - 14. Data needed to acquire Owner's insurance.
  - 15. Initial settlement survey and damage report if required.
- G. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
  - 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  - 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- H. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
  - 1. Evidence of completion of Project closeout requirements.
  - 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  - 3. Updated final statement, accounting for final changes to the Contract Sum.

Window Rock Office Building and Site

Construction Documents

4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### 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 provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Project meetings.
  - 2. Requests for Interpretation (RFIs).
- B. Related Sections include the following:
  - 1. Division 1 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
  - 2. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Division 1 Section "Closeout Procedures" for coordinating closeout of the Contract.

#### 1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
  - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:



Window Rock Office Building and Site  
Construction Documents

1. Preparation of Contractor's Construction Schedule.
  2. Preparation of the Schedule of Values.
  3. Installation and removal of temporary facilities and controls.
  4. Delivery and processing of submittals.
  5. Progress meetings.
  6. Preinstallation conferences.
  7. Project closeout activities.
  8. Startup and adjustment of systems.
  9. Project closeout activities.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

#### 1.4 SUBMITTALS

#### 1.5 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
  4. Frequency of Attendance by Architect: Limited by Architect/Owner Contract.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Critical work sequencing and long-lead items.
    - c. Designation of key personnel and their duties.
    - d. Procedures for processing field decisions and Change Orders.
    - e. Procedures for RFIs.
    - f. Procedures for testing and inspecting.
    - g. Procedures for processing Applications for Payment.
    - h. Distribution of the Contract Documents.
    - i. Submittal procedures.
    - j. Preparation of Record Documents.
    - k. Use of the premises.
    - l. Work restrictions.

Window Rock Office Building and Site  
Construction Documents

- m. Owner's occupancy requirements.
  - n. Responsibility for temporary facilities and controls.
  - o. Construction waste management and recycling.
  - p. Parking availability.
  - q. Office, work, and storage areas.
  - r. Equipment deliveries and priorities.
  - s. First aid.
  - t. Security.
  - u. Progress cleaning.
  - v. Working hours.
3. Minutes: Record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. The Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility problems.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written recommendations.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.
    - s. Regulations of authorities having jurisdiction.
    - t. Testing and inspecting requirements.
    - u. Installation procedures.
    - v. Coordination with other work.
    - w. Required performance results.
    - x. Protection of adjacent work.
    - y. Protection of construction and personnel.
  - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  - 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
  - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.

Window Rock Office Building and Site  
Construction Documents

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
  - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - 1) Review schedule for next period.
  - b. Review present and future needs of each entity present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Status of submittals.
    - 4) Deliveries.
    - 5) Off-site fabrication.
    - 6) Access.
    - 7) Site utilization.
    - 8) Temporary facilities and controls.
    - 9) Work hours.
    - 10) Hazards and risks.
    - 11) Progress cleaning.
    - 12) Quality and work standards.
    - 13) Status of correction of deficient items.
    - 14) Field observations.
    - 15) RFIs.
    - 16) Status of proposal requests.
    - 17) Pending changes.
    - 18) Status of Change Orders.
    - 19) Pending claims and disputes.
    - 20) Documentation of information for payment requests.
3. Minutes: Record the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
  - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.6 RFIs:

A. General:

1. Contractor may submit a RFI to the Architect seeking clarification or interpretation of the contract documents. If in the Contractor's opinion the nature of the RFI requires a discussion, rather than simply an answer, the Contractor shall call the Architect to have such a discussion. The results of that discussion as well as all other RFI's must be presented in writing on a form approved in advanced by the Architect along with any supporting information or data, as well as the Contractor's recommended resolution. An oral RFI or a RFI presented on an unapproved form, or without adequate supporting information and

Window Rock Office Building and Site  
Construction Documents

- Contractor's recommended solution, will be attributed solely to the contractor. Architect's review of or responses to RFI's shall not constitute an approval, direction, or procedure related to the construction means, methods, techniques, sequences, or procedures of the Contractor.
2. Architect's review of or responses to RFI's shall not constitute an approval, direction, or procedure related to the construction site safety precautions, procedures, or methodology of the Contractor.
  3. The use of a RFI is limited to clarification of the contract documents. Contractor will limit each RFI to a single issue. Information which is discernable from the contract documents; construction means and methods; product substitution submittals; product submittals; and construction site safety will not be addressed by the Architect in responding to a RFI.
  4. Architect's response to a RFI is not a change order or directive authorizing an increase in construction cost or time.
- B. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- C. Frivolous or Unnecessary RFIs: Cost of design professional's time will be billed or deducted from progress payment.
- D. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
1. Project name.
  2. Date.
  3. Name of Contractor.
  4. Name of Architect.
  5. RFI number, numbered sequentially.
  6. Specification Section number and title and related paragraphs, as appropriate.
  7. Drawing number and detail references, as appropriate.
  8. Field dimensions and conditions, as appropriate.
  9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  10. Contractor's signature.
  11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation. a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- E. Hard-Copy RFIs: Form at end of this Section.
1. Identify each page of attachments with the RFI number and sequential page number.
- F. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow 10 days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for coordination information already indicated in the Contract

Window Rock Office Building and Site  
Construction Documents

- Documents.
- d. Requests for adjustments in the Contract Time or the Contract Sum.
- e. Requests for interpretation of Architect's actions on submittals.
- f. Incomplete RFIs or RFIs with numerous errors.
- 2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
- 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal
  - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
  - 1. Project name.
  - 2. Name and address of Contractor.
  - 3. Name and address of Architect.
  - 4. RFI number including RFIs that were dropped and not submitted.
  - 5. RFI description.
  - 6. Date the RFI was submitted.
  - 7. Date Architect's response was received.
  - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 FORMS

- A. Electronic versions of attached forms will be provided upon request.
  - 1. RFI Form.
  - 2. RFI Log.

END OF SECTION 013100

RFI FORM

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Project:		RFI No:	
Project No:		Date:	
To:			
From:			
Subject:		Category	
Discipline:			
Specification Section Title:			
Section Number:	Page:	Article/Paragraph:	
Sheet Number:		Detail:	

---

Question:

Suggestion:

Attachment:  
Undersigned certifies:

- Both drawings and specification sections were thoroughly reviewed.
- Processing time for frivolous RFIs will be charged back to Contractors at A/E billable rates.

---

Desired Response Date: (However, A/E still have specified days to respond.)

Cost Impact: \$ Schedule Impact: days

Drawing Impact: Submitted by:

Signed: Date:

---

Answer:

Answered by:

Signed: Date:

---

Copies:  Owner  Consultants   
 File

---

1. A/E review of or responses to RFI's shall not constitute an approval, direction, or procedure related to the construction site safety precautions, procedures, or methodology of the Contractor.
  2. The use of a RFI is limited to clarification of the contract documents. Contractor will limit each RFI to a single issue. Information that is discernable from the contract documents; construction means and methods; product substitution submittals; product submittals; and construction site safety will not be addressed by the A/E in responding to a RFI.
  3. A/E response to a RFI is not a change order or directive authorizing an increase in construction cost or time.
- 

End of RFI Form







## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### 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 for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's Construction Schedule.
2. Submittals Schedule.
3. Three Week Look-Ahead Schedule.
4. Daily construction reports.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.

#### 1.3 SUBMITTALS

- A. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
  1. Scheduled date for first submittal.
  2. Specification Section number and title.
  3. Submittal category (action or informational).
  4. Name of subcontractor.
  5. Description of the Work covered.
  6. Scheduled date for Architect's final release or review.
- B. Contractor's Construction Schedule: Submit three opaque copies of schedule, large enough (minimum 11 x 17) to show entire schedule for entire construction period.
- C. Daily Construction Reports: Submit two copies at weekly intervals.

#### 1.4 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
  - 1. Secure time commitments for performing critical elements of the Work from parties involved.
  - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

### PART 2 - PRODUCTS

#### 2.1 SUBMITTALS SCHEDULE

- A. Concurrent with the development of the Contractor's construction schedule, prepare a complete schedule of submittals. Submit the submittal schedule with the Contractor's construction schedule described above.
  - 1. Coordinate submittal schedule with the list of subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.
  - 2. The Architect will review the schedule and indicate which submittals may be deleted from the submission requirement. The deletion of the submittal requirement for an item does not release the Contractor from any requirements of the Construction Contract, General Conditions or Plans and Specifications.
- B. Prepare the schedule in chronological order; include submittals required during the first 90 days of construction. Provide the following information:
  - 1. Scheduled date for the first submittal.
  - 2. Related Section number.
  - 3. Submittal category.
  - 4. Name of subcontractor.
  - 5. Description of the part of the Work covered.
  - 6. Scheduled date for resubmittal.
  - 7. Scheduled date the Architect's final release or review.
- C. Distribution: Following response to initial submittal, print and distribute copies to the Architect, Owner, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the project meeting room and field office.
  - 1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.
- D. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

## 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Prepare a fully developed, horizontal bar-chart type Contractor's construction schedule. Submit within 15 days of the date established for "Commencement of the Work". The Construction Schedule must be submitted and accepted prior to approval of first pay application.
1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as identified in the "Schedule of Values".
  2. Within each time bar indicate estimated completion percentage in 10 percent increments. As work progresses, place a contrasting mark in each bar to indicate Actual Completion.
  3. Prepare the schedule on a sheet, or series of sheets, of stable reproducible media, of sufficient width to show data for the entire construction period.
  4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
  5. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests and other schedules.
  6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Architect's procedures necessary for certification of Substantial Completion.
- B. Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by requirements for phased completion to permit work by separate Contractors and partial occupancy by the Owner prior to Substantial Completion.
- C. Work Stages: Indicate important stages of construction for each major portion of the Work, including testing and installation.
- D. Area Separations: Provide a separate time bar to identify each major construction area for each major portion of the Work. Indicate where each element in an area must be sequenced or integrated with other activities.
- E. Cost Correlation: At the head of the schedule, provide a two item cost correlation line, indicating "pre-calculated" and "actual" costs. On the line show dollar-volume of work performed as of the dates used for preparation of payment requests.
1. Refer to Section "Applications for Payment" for cost reporting and payment procedures.

## 2.3 THREE WEEK LOOK-AHEAD SCHEDULE

- A. Prepare weekly (or as determined by scheduled meeting times), prior to Project meetings, a computer-generated 3-week look-ahead schedule (bar chart) which is consistent with the Contractors schedule and depicts daily labor activities. The schedule will consist of the prior week, current week and the following 3 weeks.

## 2.4 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
  2. List of separate contractors at Project site.
  3. Approximate count of personnel at Project site.
  4. Equipment at Project site.
  5. Material deliveries.
  6. High and low temperatures and general weather conditions.
  7. Accidents.
  8. Meetings and significant decisions.
  9. Unusual events (refer to special reports).
  10. Stoppages, delays, shortages, and losses.
  11. Meter readings and similar recordings.
  12. Emergency procedures.
  13. Orders and requests of authorities having jurisdiction.
  14. Change Orders received and implemented.
  15. Construction Change Directives received and implemented.
  16. Services connected and disconnected.
  17. Equipment or system tests and startups.
  18. Partial Completions and occupancies.
  19. Substantial Completions authorized.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  2. Include a report with updated schedule that indicates changes, including, but not limited to, changes in durations, actual starts and finishes, and activity durations.
  3. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of reviewed schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
  2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

Window Rock Office Building and Site  
Construction Documents

3.2 FORMS

- A. Electronic versions of attached forms will be provided upon request.
  - 1. Submittals Schedule Form.

END OF SECTION 013200



## SECTION 013300 - SUBMITTAL PROCEDURES

### 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 for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Consult individual sections of specifications for specific submittals required under those sections and for further details and descriptions of requirements.
- C. Related Sections include the following:
  - 1. Division 1 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
  - 2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
  - 3. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
  - 4. Division 1 Section "Quality Requirements" for submitting test and inspection reports.
  - 5. Division 1 Section "Closeout Procedures" for submitting warranties.
  - 6. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 7. Division 1 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
  - 8. Division 1 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
  - 9. Other Sections for specific requirements for submittals in those Sections.

#### 1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

#### 1.4 SUBMITTAL PROCEDURES

- A. Processing: All costs for printing, preparing, packaging, submitting, mailing, or delivering submittals for initial submittals and all costs for re-printing, re-drawing, re-drafting, re-packaging, re-submitting, and re-mailing or re-delivering as required for all re-submittals shall be included in Contract Sum.
- B. Sequence: Transmit each submittal in sequence which will not result in Architect's approval having to be later modified or rescinded by reason of subsequent submittals which should have been processed earlier or concurrently for coordination.

Window Rock Office Building and Site  
Construction Documents

- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- E. Multiple Reviews: The Contractor shall also be responsible for all costs to Architect or Architect consultants for reviews requiring more than 2 reviews for same specification section.
- F. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  - 1. Review: Allow 7 days for review of each submittal. Architect will request for more time if needed.
- G. Identification: Place a permanent label or title block on each submittal for identification.
  - 1. Indicate name of firm or entity that prepared each submittal on label or title block.
  - 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  - 3. Include the following information on label for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name and address of Contractor.
    - e. Name and address of subcontractor.
    - f. Name and address of supplier.
    - g. Name of manufacturer.
    - h. Each submittal number shall be unique as follows:
      - 1) Format shall be as follows:
        - a) Sequential Number - Revision Number - Project Specification Section Number (e.g., 1-1-09910). Do not use letters.
      - 2) Submittal number shall be sequential starting with 1 (e.g., 1-#-#####).
      - 3) First submittal for each section shall have number 1 as the "revision" number. (e.g., #-1-#####)
      - 4) Resubmittal for same specification section shall have same first digit as the original submittal and sequential second digit revision number (e.g., #-2-##### as in second submittal).
      - 5) Sample submittal log would look like the following in the submittal number column: Note that 1-2-09910 is second submittal.



Submittal Number
1-1-099100
1-2-099100 (revised submittal: shown for clarity)
2-1-055000
3-1-077200

- i. Number and title of appropriate Specification Section.
  - j. Drawing number and detail references, as appropriate.
  - k. Location(s) where product is to be installed, as appropriate.
  - l. Other necessary identification.
- H. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- I. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
- 1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
  - 2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.
- J. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
- 1. Transmittal Form: Use AIA Document G810.
- K. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- 1. Note date and content of previous submittal.
  - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  - 3. Resubmit submittals until they are marked "Approved" or "Furnish as Noted".
- L. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- M. Use for Construction: Use only final submittals with mark indicating approval by Architect.

## PART 2 - PRODUCTS

### 2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
    - a. Circle items applicable.

## Window Rock Office Building and Site

### Construction Documents

- b. Cross-out items not applicable.
    - c. Select item number if required.
  3. Submittal data must include complete documentation relating to all the specified features
  4. Include the following information, as applicable:
    - a. Manufacturer's Submittal Form with all the options selected when available.
    - b. Manufacturer's written recommendations.
    - c. Manufacturer's product specifications.
    - d. Manufacturer's installation instructions.
    - e. Standard color charts.
    - f. Manufacturer's catalog cuts.
    - g. Wiring diagrams showing factory-installed wiring.
    - h. Printed performance curves.
    - i. Operational range diagrams.
    - j. Mill reports.
    - k. Standard product operation and maintenance manuals.
    - l. Compliance with specified referenced standards.
    - m. Testing by recognized testing agency.
    - n. Application of testing agency labels and seals.
    - o. Notation of coordination requirements.
  5. Submit Product Data before or concurrent with Samples.
  6. Number of Copies: Submit 6 copies of Product Data, unless otherwise indicated. Architect will return 2 copies. Mark up and retain one returned copy as a Project Record Document.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
  1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Dimensions.
    - b. Do not use words "by others." Use words which depict exactly who is responsible for the work.
    - c. Identification of products.
    - d. Fabrication and installation drawings.
    - e. Roughing-in and setting diagrams.
    - f. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
    - g. Shopwork manufacturing instructions.
    - h. Templates and patterns.
    - i. Schedules.
    - j. Design calculations.
    - k. Compliance with specified standards.
    - l. Notation of coordination requirements.
    - m. Notation of dimensions established by field measurement.
    - n. Relationship to adjoining construction clearly indicated.
    - o. Seal and signature of professional engineer if specified.
    - p. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
  2. 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 24 by 36 inches.
  3. Number of Copies: Submit 4 sets of prints.

Window Rock Office Building and Site  
Construction Documents

- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of appropriate Specification Section.
  3. Disposition: Maintain sets of approved Samples at Project site, available for quality control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit 1 full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
  5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
      - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product.
  2. Number and name of room or space.
  3. Location within room or space.
  4. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
    - a. Mark up and retain one returned copy as a Project Record Document.
- F. Submittals Schedule: Comply with requirements specified in Division 1 Section "Construction

Window Rock Office Building and Site

Construction Documents

Progress Documentation."

- G. Application for Payment: Comply with requirements specified in Division 1 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 1 Section "Payment Procedures."

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
  - 1. Number of Copies: Submit 2 copies of each submittal, unless otherwise indicated. Architect will not return copies.
  - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
  - 3. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination."
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- G. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- J. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on

Window Rock Office Building and Site  
Construction Documents

evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

- K. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
1. Name of evaluation organization.
  2. Date of evaluation.
  3. Time period when report is in effect.
  4. Product and manufacturers' names.
  5. Description of product.
  6. Test procedures and results.
  7. Limitations of use.
- L. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Requirements."
- M. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- N. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- O. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 1 Section "Operation and Maintenance Data."
- Q. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
  2. Required substrate tolerances.
  3. Sequence of installation or erection.
  4. Required installation tolerances.
  5. Required adjustments.
  6. Recommendations for cleaning and protection.

## Window Rock Office Building and Site

### Construction Documents

- S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
  - 1. Name, address, and telephone number of factory-authorized service representative making report.
  - 2. Statement on condition of substrates and their acceptability for installation of product.
  - 3. Statement that products at Project site comply with requirements.
  - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  - 6. Statement whether conditions, products, and installation will affect warranty.
  - 7. Other required items indicated in individual Specification Sections.
  
- T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

### 2.3 DEFERRED APPROVALS AND DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
  
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit 3 copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
  - 1. Coordinate the work; do not delegate responsibility for coordination to any subcontractor.
  - 2. Anticipate the interrelationship of all subcontractors and their relationship with the total work.
  - 3. Resolve differences or disputes between subcontractors and materials suppliers concerning coordination, interference, or extent of work between sections.
  - 4. Trade submittals with "By Others", "By General Contractor", or similar coordination and work scope are not allowed. Identify, acknowledge, and resolve scope of work prior to submittal by Contractor. No extras will be allowed. Provide complete and coordinated submittals.
  
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date

Window Rock Office Building and Site  
Construction Documents

of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.
- F. Architect's and Consultant's review shall neither be construed as complete check nor relieve the Contractor, Subcontractor, manufacturer, fabricator, or supplier from responsibility for any deficiency that may exist or from any departures or deviations from the requirements of the Contract unless the Contractor has, in writing, called the Architect's attention to the deviations at the time of submission as specified.

END OF SECTION 013300

## SECTION 014000 - QUALITY REQUIREMENTS

### 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 for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
  - 1. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
  - 2. Other Sections for specific test and inspection requirements.

#### 1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups:
  - 1. Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
  - 2. Comprehensive, completely integrated mockups of separate trades showing interface conditions, transitions, and relationships between materials and finishes.



Window Rock Office Building and Site  
Construction Documents

- D. **Product Testing:** Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- E. **Source Quality-Control Testing:** Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- F. **Field Quality-Control Testing:** Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. **Testing Agency:** An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. **Installer/Applicator/Erector:** Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- I. **Experienced:** When used with an entity, "experienced" means having successfully completed a minimum of 5 previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

#### 1.4 CONFLICTING REQUIREMENTS

- A. **General:** If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.
- C. **In case of conflicting requirements between the General Conditions and the Specifications,** comply with the General Conditions.

#### 1.5 SUBMITTALS

- A. **Qualification Data:** For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. **Schedule of Tests and Inspections:** Prepare in tabular form and include the following:

## Window Rock Office Building and Site

### Construction Documents

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

### 1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A licensed professional engineer who is legally qualified to practice in California and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system,

Window Rock Office Building and Site  
Construction Documents

assembly, or product that are similar to those indicated for this Project in material, design, and extent.

- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirement for specialists shall not supersede building codes and regulations governing the Work.
  
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
  - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
  
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
  
- I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
  - 2. Notify Architect 7 days in advance of dates and times when mockups will be constructed.
  - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
  - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 6. Demolish and remove mockups when directed, unless otherwise indicated.

## 1.7 QUALITY CONTROL

- A. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."
  
- B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
  
- C. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
  - 1. Access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.

## Window Rock Office Building and Site

### Construction Documents

3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspecting equipment at Project site.
- D. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- E. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 TEST AND INSPECTION LOG

- A. Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

#### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

## SECTION 014200 - REFERENCES

### 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 list of references.

#### 1.3 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "AHJ": Agency having jurisdiction.
- C. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- D. "Compatible": When used for products, it shall comply with requirements including products recommended/ required by the manufacturer for warrantee acceptance.
- E. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- F. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- G. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- H. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- I. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- J. "Owner": As defined in Division 1 section "Summary".
- K. "Provide": Furnish and install, complete and ready for the intended use.

Window Rock Office Building and Site  
Construction Documents

- L. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.4 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
  - 2. Copies of standards and applicable building codes (Title 24 Parts 1-5) shall be kept on-site during construction.
- D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations.
- E. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized names.
- F. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized names.
- G. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized names.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

### 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 requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections include the following:
  - 1. Division 1 Section "Summary" for limitations on utility interruptions and other work restrictions.
  - 2. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
  - 3. Division 1 Section "Execution Requirements" for progress cleaning requirements.
  - 4. Other Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

#### 1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

#### 1.4 USE CHARGES

- A. General: Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: No sewer is available.
- C. Water Service:
  - 1. Water from Owner's existing water system is available for use without metering and without payment of use charges unless required by the city. Provide connections and extensions of services as required for construction operations.
- D. Electric Power Service:
  - 1. Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- E. Sanitary Facilities:

Window Rock Office Building and Site  
Construction Documents

1. Pay sanitary service use charge for temporary toilets, wash facilities, and drinking water for use of construction personnel.

1.5 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.6 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with 2010 CEC.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch, 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized steel bases for supporting posts.

2.2 TEMPORARY FIELD OFFICES

- A. Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading located within construction area or within 30 feet of building lines. Comply with NFPA 241.
- B. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- C. Sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices and pay for services for following:
  1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
  2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack board.
  3. Drinking water and private toilet.



4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

### 2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, electric, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Install temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Install temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

- F. Ventilation and Humidity Control: Install temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- G. Electric Power Service: Install electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
- H. Lighting: Install temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
  - 2. Install lighting for Project identification sign.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- B. Parking: Provide temporary or use designated areas of Owner's existing parking areas if approved for construction personnel.
- C. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
  - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
  - 2. Remove snow and ice as required to minimize accumulations.
- D. Project Identification and Temporary Signs: Provide Project identification. Install signs where directed to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
  - 1. Provide temporary, directional signs for construction personnel and visitors.
  - 2. Maintain and touchup signs so they are legible at all times.
  - 3. Provide a 4'-0" x 8'-0" project sign constructed of 1/2 inch plywood or 10 mil corrugated mounted to 4"x4" posts 8'-0" long set 2'-0" deep into earth.
  - 4. Project sign shall include a graphic of the building (available from the Architect), Architect, Consultants, Owner, project, funding members with titles, and Contractor with contact information for the contractor. Text and layout shall be submitted for approval prior to installation.
  - 5. Location of project sign shall be coordinated with Owner's representative.
- E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.

### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

Window Rock Office Building and Site  
Construction Documents

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  - 1. Comply with work restrictions specified in Division 1 Section "Summary."
- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
  - 1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
  - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations or as indicated on Drawings.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.
- F. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- I. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with 2010 CFC Article 87.
  - 1. Prohibit smoking in construction areas.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning

sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  - 2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 1 Section "Closeout Procedures."

END OF SECTION 015000

## SECTION 016000 - PRODUCT REQUIREMENTS

### 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 for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and product substitutions.
- B. Related Sections include the following:
  - 1. Division 1 Section "References" for applicable industry standards for products specified.
  - 2. Division 1 Section "Closeout Procedures" for submitting warranties for Contract closeout.
  - 3. Other Sections for specific requirements for warranties on products and installations specified to be warranted.

#### 1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Proposed products by manufacturers not listed in Manufacturers list.
- C. Basis-of-Design: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating "or equal" products of other named manufacturers.

#### 1.4 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
  2. Form: Tabulate information for each product under the following column headings:
    - a. Specification Section number and title.
    - b. Generic name used in the Contract Documents.
    - c. Proprietary name, model number, and similar designations.
    - d. Manufacturer's name and address.
    - e. Supplier's name and address.
    - f. Installer's name and address.
    - g. Projected delivery date or time span of delivery period.
    - h. Identification of items that require early submittal approval for scheduled delivery date.
  3. Completed List: Submit 3 copies of completed product list within days specified in General Conditions. Include a written explanation for omissions of data and for variations from Contract requirements.
  4. Architect's Action: Architect will respond in writing to Contractor within 21 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.
- B. Substitution Requests: Submit 4 copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form: Use form provided at end of Section.
  2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified material or product cannot be provided.
    - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, environmental, and specific features and requirements indicated.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

- i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
  - j. Cost information, including a proposal of change, if any, in the Contract Sum.
  - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
  - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: Architect will notify Contractor of acceptance or rejection of proposed substitution within 21 days of receipt of request.
- a. Form of Acceptance: Change Order.
  - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

- C. Named Product and Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

#### 1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

#### 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
- C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
  2. Store materials in a manner that will not endanger Project structure.
  3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
  4. Store cementitious products and materials on elevated platforms.
  5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

## 1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
  1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
  3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Warranty Period: Warranty period specified in each sections are minimum requirements. Do not modify manufacturer's standard warranty period if the manufacturer's warranty has longer warranty period.
- D. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
  1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.



6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or an equal product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with "or equal".
6. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Product Substitutions" Article to obtain approval by Architect for use of an unnamed product.
7. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
8. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
  - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include custom or premium items.
  - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes standard, custom, and premium items.

## 2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within 35 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
  1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect

- for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
  3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  4. Substitution request is fully documented and properly submitted.
  5. Requested substitution will not adversely affect Contractor's Construction Schedule.
  6. Requested substitution has received necessary approvals of authorities having jurisdiction and has paid any fees.
  7. Requested substitution is compatible with other portions of the Work.
  8. Requested substitution has been coordinated with other portions of the Work.
  9. Requested substitution provides specified warranty.
  10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
  11. Furnish samples upon requested by Architect.
  12. Attached Request for Substitution Form shall used for substitution requests.
- C. Substitutions for products or systems involving structural, fire/life safety and access compliance will be considered a Change Order or Addendum, and will require AHJ approval. This will add time required to review those substitutions requiring AHJ approval. Contractor is solely responsible for all documentation and time required to obtain AHJ approval.
1. The use of a product other than specified or noted on the Drawings will require the Contractor to get Engineer, Architect and AHJ approval.
  2. The Contractor shall be responsible to provide any information, calculations or drawings to show compliance with the AHJ approved drawings and provide all documentation to the Architect and/or Engineer of record.
  3. Any changes or "substitutions" that impact or relate to DSA requirements for structural, ADA or fire and life safety MUST be approved by DSA prior to proceeding with the work.
  4. The Contractor shall also be responsible for all costs to the AHJ, Architect or Architect consultants for review, co-ordination, and approval by the AHJ.
    - a. All costs for submittal to AHJ and Architect/ design team expenses shall be back charged to the Contractor.

## PART 3 - EXECUTION

### 3.1 FORMS

- A. Electronic versions of attached forms will be provided upon request.
1. Product List Form.
  2. Similar Installation List Form.
  3. Substitution Request Form.

END OF SECTION 016000

## SUBSTITUTION REQUEST FORM

Substitutions are only allowed within number of days specified. Use this for m for requesting “or equal” products and materials.

Project:	Substitution Request Number:
	From:
To:	Date:
	Project Number:

Specification Section Title:		
Section Number:	Page:	Article/Paragraph:
Specified Item:		

Proposed Substitution:	
Manufacturer:	Address:
Contact Name:	Phone Number:
<input type="checkbox"/> Comparison between proposed substitution and specified product is attached. Note all differences.	

Reason for not using specified item:

- Specified product is no longer available.
- Substitution will improve lead time by \_\_\_\_\_ days
- Substitution will save Owner \$ \_\_\_\_\_
- Other:

List 3 similar installations including project name, address, owner, and date installed is attached.  
Proposed substitution affects other parts of Work:     No     Yes; explanation attached.

Supporting Data Attached:

- Product Data (indicate any options to be included)
- Drawings     Test Reports     Samples     Color Chart     Other:

Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable is available.
- Proposed substitution will not affect or delay Construction Progress Schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including architectural or engineering design, detailing, and construction costs caused by the requested substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

- Substitutions for products or systems involving structural, fire/life safety and access compliance will require AHJ approval. This will add time required to review those substitutions requiring AHJ approval. Contractor is solely responsible for all documentation, cost, and time required to obtain AHJ approval.

Submitted by:	Firm:
Signature:	Date:
Comments:	

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A/E Review:

- Approve Substitution.
- Approve Substitution as Noted.
- Reject Substitution. Use specified product.
- Reject Substitution. Use specified product. Substitution request received too late.

Signed by:	Date:
Comments:	

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Owner's Review and Action (Approval of substitution is not valid without Owner's signature)

- Substitution approved.
- Substitution approved as Noted.
- Substitution rejected. Use specified product.

Signed by:	Date:
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Comments:
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End of Substitution Request Form



## SIMILAR INSTALLATION LIST FORM

Provide minimum 5 similar installations within last 3 years.

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Project: \_\_\_\_\_ From: \_\_\_\_\_

To: \_\_\_\_\_ Date \_\_\_\_\_

	<b>Date of Installatio</b>	<b>Project Name</b>	<b>Owner Info</b>	<b>GC Info</b>	<b>Architect info</b>
<b>1</b>					
<b>2</b>					
<b>3</b>					
<b>4</b>					
<b>5</b>					
<b>6</b>					
<b>7</b>					
<b>8</b>					



## SECTION 017300 - EXECUTION REQUIREMENTS

### 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 general procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. General installation of products.
  - 3. Progress cleaning.
  - 4. Starting and adjusting.
  - 5. Protection of installed construction.
  - 6. Correction of the Work.
- B. Related Sections include the following:
  - 1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
  - 2. Division 1 Section "Submittal Procedures" for submitting surveys.
  - 3. Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

#### 1.3 SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- D. Certified Surveys: Submit 2 copies signed by professional engineer.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 EXAMINATION



- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
  - 1. Before construction, verify the location and points of connection of utility services.
  
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas, and water-service piping; and underground electrical services.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
  
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
  
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
  
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
  - 4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.

3. Coordinate installation of anchorages. 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.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.5 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction forces.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
  1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
  2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

### 3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
  1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

### 3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Provide protection against weather, rain, wind, storms, frost and heat so as to maintain all work and materials free from injury or damage.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

### 3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."

Window Rock Office Building and Site  
Construction Documents

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

## SECTION 017329 - CUTTING AND PATCHING

### 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 procedural requirements for cutting and patching.
- B. Related Sections include the following:
  - 1. Divisions 2 through 26 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

#### 1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

#### 1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
  - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
  - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
  - 3. Products: List products to be used and firms or entities that will perform the Work.
  - 4. Dates: Indicate when cutting and patching will be performed.
  - 5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
  - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.

7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

## 1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

## 1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
  1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
  2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

### 3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and 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.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
  - 2. Exposed Finishes: 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.



Window Rock Office Building and Site  
Construction Documents

- a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
  - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

## SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT

### 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 administrative and procedural requirements for the following:
  - 1. Salvaging nonhazardous construction waste.
  - 2. Recycling nonhazardous construction waste.
  - 3. Disposing of nonhazardous construction waste.
- B. Related Sections include the following:
  - 1. Division 1 Section "Temporary Facilities and Controls" for environmental-protection measures during construction.

#### 1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- C. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- D. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- E. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

#### 1.4 PERFORMANCE GOALS

- A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of 75 percent by weight of total waste generated by the Work.
  - 1. Not a requirement, but a goal for sustainable design. No extra cost should incur to Owner.

### 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Waste Management Conference: include in Kick-Off meeting Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
  - 1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
  - 2. Review requirements for documenting quantities of each type of waste and its disposition.
  - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
  - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
  - 5. Review waste management requirements for each trade.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 RECYCLING CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
  - 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    - a. Inspect containers and bins for contamination and remove contaminated materials if found.
  - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
  - 4. Store components off the ground and protect from the weather.
  - 5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

#### 3.2 DISPOSAL OF WASTE

Window Rock Office Building and Site  
Construction Documents

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

## SECTION 017700 - CLOSEOUT PROCEDURES

### 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 for contract closeout, including, but not limited to, the following:
  - 1. Warranties.
  - 2. Extra Materials.
  - 3. Final cleaning.
- B. Related Sections include the following:
  - 1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
  - 2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
  - 3. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 4. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 5. Division 1 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
  - 6. Other Sections for specific closeout and special cleaning requirements for the Work in those Sections.

#### 1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Advise Owner of pending insurance changeover requirements.
  - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  8. Complete startup testing of systems.
  9. Submit test/adjust/balance records.
  10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  11. Advise Owner of changeover in heat and other utilities.
  12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  13. Complete final cleaning requirements, including touchup painting.
  14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection process or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for Final Completion.

#### 1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
  2. Submit certified copy of Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report and warranty.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection process for acceptance. On receipt of request, Architect will either proceed with inspection process or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction

including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use form attached.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
  - a. Project name.
  - b. Date.
  - c. Name of Architect.
  - d. Name of Contractor.
  - e. Page number.

## 1.6 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date specified in General Conditions.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
  1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  2. Include Table of Contents.
  3. Identify content with specification section number and title.
  4. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  5. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

## 1.7 EXTRA MATERIALS

- A. Deliver to Owner's facility manager extra materials specified in each section.
- B. Organize submitted materials in orderly sequence based on the table of contents of the Project Manual.
  1. Itemize each material and quantity in 8-1/2 by 11-inch paper.
- C. Label each items for easy identification.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting IOR's inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access to building.
    - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Sweep concrete floors broom clean in unoccupied spaces.
    - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
    - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - k. Remove labels that are not permanent.
    - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
    - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    - n. Replace parts subject to unusual operating conditions.
    - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
    - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply



- s. with requirements for new fixtures.
- s. Leave Project clean and ready for occupancy.

3.2 FORMS

- A. Electronic versions of attached forms will be provided upon request.
  - 1. Punch-List Form.

END OF SECTION 017700





## SECTION 017823 - OPERATION AND MAINTENANCE DATA

### 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 for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory.
  - 2. Emergency manuals.
  - 3. Operation manuals for systems, subsystems, and equipment.
  - 4. Maintenance manuals for the care and maintenance of products, materials, and finishes.
- B. Related Sections include the following:
  - 1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
  - 2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
  - 3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
  - 4. Other Sections for specific operation and maintenance manual requirements for the Work in those Sections.

#### 1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

#### 1.4 SUBMITTALS

- A. Initial Submittal: Submit 2 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return 1 copy of draft and mark whether general scope and content of manual are acceptable.
- B. Final Submittal: Submit 1 copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
  - 1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

#### 1.5 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

## PART 2 - PRODUCTS

### 2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
  - 1. List of documents.
  - 2. List of systems.
  - 3. List of equipment.
  - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

### 2.2 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name, address, and telephone number of Contractor.
  - 6. Name and address of Architect.
  - 7. Cross-reference to related systems in other operation and maintenance manuals.

Window Rock Office Building and Site  
Construction Documents

- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
  - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
  
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
  - 1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
  - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
  - 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
  - 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

### 2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
  - 1. Type of emergency.
  - 2. Emergency instructions.
  - 3. Emergency procedures.
  
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
  - 1. Fire.
  - 2. Flood.
  - 3. Gas leak.
  - 4. Water leak.
  - 5. Power failure.
  - 6. Water outage.

Window Rock Office Building and Site  
Construction Documents

7. System, subsystem, or equipment failure.
  8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
  2. Shutdown instructions for each type of emergency.
  3. Operating instructions for conditions outside normal operating limits.
  4. Required sequences for electric or electronic systems.
  5. Special operating instructions and procedures.

## 2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.
  2. Performance and design criteria if Contractor is delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.
  9. Precautions against improper use.
  10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.

- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

## 2.5 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

## 2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each



product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

- C. **Manufacturers' Maintenance Documentation:** Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard printed maintenance instructions and bulletins.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
  
- D. **Maintenance Procedures:** Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training videotape, if available.
  
- E. **Maintenance and Service Schedules:** Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - 1. **Scheduled Maintenance and Service:** Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - 2. **Maintenance and Service Record:** Include manufacturers' forms for recording maintenance.
  
- F. **Spare Parts List and Source Information:** Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
  
- G. **Maintenance Service Contracts:** Include copies of maintenance agreements with name and telephone number of service agent.
  
- H. **Warranties and Bonds:** Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

## PART 3 – EXECUTION

### 3.1 MANUAL PREPARATION

- A. **Operation and Maintenance Documentation Directory:** Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
  
- B. **Emergency Manual:** Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

Window Rock Office Building and Site  
Construction Documents

- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
  - 2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."
- G. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

## SECTION 017839 - PROJECT RECORD DOCUMENTS

### 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 for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
- B. Related Sections include the following:
  - 1. Division 1 Section "Closeout Procedures" for general closeout procedures.
  - 2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 3. Other Sections for specific requirements for Project Record Documents of the Work in those Sections.

#### 1.3 SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit 1 set of marked-up Record Prints.
- B. Record Specifications: Submit 1 copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit 1 copy of each Product Data submittal.
  - 1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

### PART 2 - PRODUCTS

#### 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an understandable drawing technique.
    - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations below first floor.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
  4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize Record Prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."

- d. Name of Architect.
- e. Name of Contractor.

## 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  - 4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
  - 5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

## 2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
  - 4. Assembly in single binder with table of contents.

## 2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

# PART 3 - EXECUTION

## 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

Window Rock Office Building and Site  
Construction Documents

- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

3.2 FORMS

- A. Electronic versions of attached forms will be provided upon request.
  - 1. Record Product Data Form.

END OF SECTION 017839

# RECORD PRODUCT DATA FORM

Record Product Data is due no later than 10 calendar days after the date of Substantial Completion. Photocopy for continuation sheets. List products in order by specification section numbers.

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Project Name:	From:
To:	Date:

Spec Section		Originally Specified		Actually Installed	
No.	Title	Model	Manufacturer	Model	Manufacturer

End of Record Product Data Form

## SECTION 017900 - DEMONSTRATION AND TRAINING

### 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 for instructing Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. Related Sections include the following:
  - 1. Division 1 Section "Project Management and Coordination" for requirements for preinstruction conferences.
  - 2. Other Sections for specific requirements for demonstration and training for products in those Sections.

#### 1.3 SUBMITTALS

- A. Instruction Program: Submit 2 copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. At completion of training, submit 1 complete training manual(s) for Owner's use.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

#### 1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with



Window Rock Office Building and Site  
Construction Documents

requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

Window Rock Office Building and Site  
Construction Documents

- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Schedule training with Owner, through Architect, with at least 7 days' advance notice.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written performance-based test.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 017900

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.0 DESCRIPTION

- A. The work of this section consists of furnishing and placing concrete, including formwork, reinforcement, joints, finishing, curing, and all related work. The work also includes required materials testing.
- B. Related Work:
  - 1. Section 31 00 00: Earthwork.
  - 2. Section 05 12 00: Structural Steel.

1.1 REFERENCES (latest revision unless noted otherwise)

- A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
- B. ACI 301 - Specifications of Structural Concrete for Buildings.
- C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- D. ACI 305 and 306 - Hot and Cold Weather Protection for Concrete.
- E. ACI 309 - Recommended Practice for Consolidation of Concrete.
- F. ACI 315 - Details and Detailing of Concrete Reinforcement.
- G. ACI 318 - Building Code Requirements for Reinforced Concrete.
- H. ACI 347 - Recommended Practice for Concrete Formwork.
- J. ANSI/ASTM A82 - Cold Drawn Steel Wire for Concrete Reinforcement.
- K. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- L. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
- M. ASTM C33 - Concrete Aggregates.
- N. ASTM C94 - Ready-Mixed Concrete.
- O. ASTM C150 - Portland Cement.
- P. ASTM C260 - Air Entraining Admixtures for Concrete.
- Q. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

- R. ASTM C494 - Water Reducing Admixtures for Concrete.
- S. ASTM C618 - Fly Ash Mineral Admixture for Concrete.
- T. CRSI - Manual of Standard Practice.

## 1.2 QUALITY ASSURANCE

- A. Testing of concrete shall be the responsibility of the Contractor. Work and materials which are defective shall be repaired or replaced and re-tested at the Contractor's expense. All testing shall be performed by a certified independent Testing Agency.
- B. Special Inspection: Special Inspection is required as per the requirements set forth in the International Building Code (IBC) 2012, Section 17.
- C. Concrete Mix Design (Ready-Mix):
  - 1. Strength Requirements: ASTM C 94.
  - 2. Testing:
    - a. Slump and Air Content Tests: Samples shall be taken from every truck after discharge of approximately 15 percent of load. If slumps differ by more than 2 inches, the mixer or agitator shall not be used until condition causing this variation is corrected. The equipment for these tests will be furnished by Contractor's certified independent testing laboratory technician.
    - b. Compression Tests: Test specimens shall be made and cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39, using standard 6-inch diameter by 12-inch high cylinders or 4-inch diameter by 8-inch high cylinders, and will be taken by the Contractor's certified independent testing laboratory technician. Curing, shipment to, and testing by an independent laboratory shall be at the expense of the Contractor. The Contractor shall obtain 4 cylinders for every 50 cubic yards of concrete placed or for each major placement during the day whichever is more frequent. One cylinder shall be tested at an age of 7 days for information, two at an age of 28 days for acceptance, and one held in reserve to be tested if required.
    - c. Results of concrete testing shall be reported in accordance with Section 1.4.C.
  - 3. Enforcement of Strength Requirements: If the 28-day strength test fails to meet the requirements of ASTM C 94, the owner may require that core samples be taken and tested in accordance with ASTM C 42, at Contractor's expense. If the core tests are below strength, if there is evidence of damage by freezing, or if the concrete fails to meet specifications in other ways, the owner may require that the defective concrete be removed and replaced at no additional expense to the owner.
- D. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.
  - 1. Inspection or testing does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents.
  - 2. Workmanship: The Contractor is responsible for and shall bear the cost of correcting concrete work which does not conform to the specified requirements including, but not limited to, strength, tolerances, joint types and patterns, and finishes. Correct deficient

concrete by means acceptable to the owner. The cost of extra work incurred to approve corrective work shall be borne by the Contractor.

- E. Record of Work: A record shall be kept by the General Contractor listing the time and date of placement of all concrete for the structure. Such record shall be kept until the completion of the project and shall be available to the owner for examination at any time.

### 1.3 SUBMITTALS

- A. Shop Drawings:
  - 1. All shop drawings shall be original drawings and shall not be reproductions of the contract documents.
  - 2. Drawings: Submit detailed drawings for fabrication, bending and placement of concrete reinforcement indicating size, dimension, bending, placing and construction joint details. Submit drawing showing locations of any construction joints not shown. Drawings shall be on minimum 18-inch by 24-inch drafting paper. Include all accessories specified and required to support reinforcement. Comply with ACI Detailing Manual SP 66 and requirements of ACI 318.
- B. Product Data:
  - 1. Submit data for proprietary materials and items, including admixtures, patching compounds, joint systems, curing compounds, sealants, and other as requested by the Government.
  - 2. Submit certifications that curing compound (if used) is compatible with finishes.
- C. Certificates and Reports (Ready-Mix Concrete):
  - 1. Concrete Mix Design: Comply with ASTM C 94; furnish statement of composition of concrete mix and evidence that mix will meet quality specified herein, including cement content, fly ash content, entrained air content, design slump and unit weight.
  - 2. Admixtures: Submit admixture types and manufacturers with a written statement showing chloride content if any chloride was added during manufacture.
  - 3. Submit results to the owner of concrete slump, air content, and compressive strength tests.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. General: Materials handling and batching shall conform to applicable provisions of ASTM C94.
- B. Reinforcing: Unload and store reinforcing bars so they will be kept free of mud and damage.
- C. Extra Water:
  - 1. Deliver concrete to site in exact quantities required by design mix.
  - 2. Should extra water be required for workability before depositing concrete and water/cement ratio of accepted mix design has not been exceeded, the General Contractor's superintendent shall have sole authority to authorize addition of water. Any additional water added to mix after leaving batch plant shall be indicated on truck ticket and signed by person responsible.
  - 3. Where extra water is added to concrete it shall be mixed thoroughly for 50 revolutions of

drum before depositing.

4. Water may be added to the site only once for each batch.
5. An additional slump and air content test shall be performed following the addition of any water.

- D. Re-dosage with High Range Water Reducing Mixture (Superplasticizer): May be done with prior acceptance of owner regarding dosage and time periods.

## 1.5 JOB CONDITIONS

### A. Environmental Requirements:

#### 1. Cold Weather Placement:

- a. When for three successive days prior to concrete placement the average daily outdoor temperature drops below 40o F or when the average outdoor temperature is expected to drop below 40o F on the day of concrete placement, preparation, protection and curing of concrete shall comply with ACI 306.R.
- b. Concrete temperature at time of placement shall conform to minimum values of ACI 306.R, and shall not exceed minimum values by more than 20o F.
- c. Subject to acceptance of owner an accelerating admixture may be used. Admixtures shall meet requirements of Part 2. Calcium Chloride and other chloride type accelerating admixtures will not be allowed.
- d. Comply with concrete protection temperature requirements of ACI 306.R. Record concrete temperatures during specified protection period at intervals not to exceed 16 hours and no less than twice during any 24 hour period.
- e. Submittal of detailed procedures, means, and methods, for production, transportation, placement, protection, curing, and temperature monitoring of concrete during cold weather is required.

#### 2. Hot Weather Placement:

- a. When depositing concrete in hot weather, follow recommendations of ACI 305R.
- b. Temperature of concrete at time of placement shall not exceed 85o F.
- c. When air temperatures on day of placement are expected to exceed 90o F, mix ingredients shall be cooled before mixing. Flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of mix water.
- d. Retarding admixture may be used subject to acceptance of owner. Admixtures shall meet requirements of Part 2.
- e. Protect to prevent rapid drying. Start finishing and curing as soon as possible.

- B. Protection: Protect newly finished slabs from rain damage. Protect finished slabs from mortar leakage from pouring of concrete above. Cover masonry walls, glazing, and other finish materials with polyethylene or otherwise protect from damage due to pouring of concrete.

## PART 2 - PRODUCTS

### 2.0 FORMWORK

- A. Contractor shall be responsible for design, strength, and safety of formwork. Formwork shall be designed to withstand vibrator action. Design, strength, spans, details, etc. of forms, shall be the Contractor's responsibility, and shall be in full conformance with the form manufacturer's

recommendations.

- B. Form-side Materials:
  - 1. Concrete exposed to view shall have smooth form finish. Use metal or plastic lined panels or overlay plywood complying with PS 1, A-C or B-B High Density Overlaid Concrete Form, Class I, which will produce a smooth, hard, uniform texture on the concrete. Do not use materials with raised grain, torn surfaces, worn edges, patches, dents, or other defects that will impair the surface of the concrete. Furnish panels in largest practical sizes to minimize number of joints and to conform to joint system shown. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
  - 2. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.
  - 3. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.
  - 4. Inspection should occur prior to placing concrete. Forms should be inspected for cleanliness, accuracy of alignment, and reinforcing steel clearances.
- C. Form Ties: Form ties shall be snap-off metal type, of required length, 1 inch diameter cone ends at exposed concrete. Form ties shall be constructed so that no metal remains within 1 1/2 inch of the surface of the wall after removal of formwork
- D. Fillets for Chamfered Corners: Wood strips or rigid plastic type; size as detailed; maximum possible lengths.
- E. Slab Construction Joint Forms: Galvanized steel with continuous tongue and groove.
  - 1. Subject to compliance with requirements, provide one of the following:
    - a. "Keyed Kold" - Burke Co.
    - b. "Super Screed" - Vulcan Metal Products.
- F. Slab Control Joint Forms: Molded plastic material for insertion into slab surface during finishing. Configure to provide joint depth of not less than 1/4th of the slab thickness.
  - 1. Subject to compliance with requirements, provide one of the following:
    - a. "Zipcap" - Greenstreak Plastic Products Co.
    - b. "Crack Inducer" - Progress Unlimited, Inc.
    - c. "Kold-Seal Zipper STRIP" - Vinylex Corp.

## 2.1 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, Grade 60 for ties and stirrups; Grade 60 for all other bars; billet steel deformed bars, uncoated finish. All reinforcement to be welded shall be ASTM A706, Grade 60.
- B. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 60 percent.

- C. Tie Wire: ASTM A82, minimum 16 gauge, annealed type.
- D. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete. Wood, brick or other unacceptable material is not permitted. Precast concrete support blocks of same or greater strength as concrete to be cast may be used as supports on grade.

## 2.2 CONCRETE

### A. General Requirements:

#### 1. Portland Cement:

- a. ASTM C 150, Type II or V. Use cement containing not more than 0.60 percent alkalis (calculated as the percentage of sodium oxide plus 0.658 times the percentage of potassium oxide) in concrete with aggregate that may be deleteriously reactive.
  - b. Use one brand of cement throughout project unless approved otherwise.
2. The use of fly ash as a cementitious component of the mix is encouraged. Fly ash shall conform to ASTM C618 Class C or F. Fly ash shall not exceed 15% of total cementitious material by weight.
3. Aggregate: ASTM C33. Obtain from same source throughout project.
- a. Fine Aggregate: Natural sand.
  - b. Coarse Aggregate: Gravel or crushed stone containing no deleterious substances which cause surface spalling.
  - c. Maximum size of coarse aggregate shall be as follows:  
For footings ..... 1-inch  
For grade beams and floor slabs..... 3/4-inch  
For concrete fill ..... 1/2-inch
4. Water: Potable.

### B. Ready-Mix Concrete:

- 1. Materials: Materials, including cement, aggregates, water, and admixtures, shall meet the requirements of ASTM C 94, subject to the additional requirements of this section.
- 2. Quality of Concrete: Concrete shall be furnished under Alternative No. 3, ASTM C 94, whereby the manufacturer assumes full responsibility for the selection of the proportions for the concrete mixture, with the minimum allowable cement content specified. Submit statement of composition as specified in Part 1 of this section.
- 3. Design compressive strength, F<sup>'</sup>c: Refer to structural foundation plan.
- 4. Air Content: 6 % +/- 1 1/2 % for footings, grade beams, and exterior slabs. Interior slabs-on-grade shall have no added air entrainment.
- 5. Slump: Shall not exceed 4 inches, with tolerances as specified in ASTM C 94.
- 6. Maximum water/cement ratio: 0.45.
- 7. Manufacture and Delivery:
  - a. Measurement of materials, batching, mixing, transporting, and delivery shall be as specified in ASTM C 94.
  - b. Hauling Time: Discharge all concrete transmitted in a truck mixer, agitator, or other transportation device not later than 1-1/2 hours, or 300 revolutions of the drum after the mixing water has been added, whichever is earliest. In hot weather, limit mixing time to 45 minutes or 125 revolutions of the drum. If the manufacturer



cannot meet these requirements, then the water and cement shall be introduced into the mix at the project site.

## 2.3 ADMIXTURES

- A. General: Unless specified, no admixtures may be used without specific approval of the owner.
- B. Characteristics: Compatible with each other and free of chlorides or other corrosive chemicals. Calcium chloride shall not be used.
- C. Air-Entraining Admixture: ASTM C260, non toxic after 30 days.
  - 1. Subject to compliance with requirements, provide one of the following:
    - a. "Air Mix" - Euclid Chemical Co.
    - b. "Darex ARA" - W. R. Grace
    - c. "Micro-Air" - Master Builders
- D. Water-Reducing Admixture: ASTM C494, Type A, B, or mid-range.
  - 1. Subject to compliance with requirements, provide one of the following:
    - a. "Eucon WR-75" - Euclid Chemical Co.
    - b. "Rheo Build 1000" - Master Builders
    - c. "Plastocrete 106" - Sika Chemical Co.
- E. High Range Water Reducing Admixture (Superplasticizer): ASTM C494, Type F or G.
  - 1. Subject to compliance with requirements, provide one of the following:
    - a. "Eucon 37" - Euclid Chemical Co.
    - b. "Pozzolith 400N" - Master Builders
    - c. "Sikament" - Sika Chemical Co.
- F. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E. The admixture manufacturer must have long-term, non-corrosive test data (of at least a year's duration) using an acceptable accelerated corrosion test method such as electrical potential measurements.
  - 1. Subject to compliance with requirements, provide one of the following:
    - a. "Accelguard 80" - Euclid Chemical Co.
    - b. "Darex Set Accelerator" - W.R. Grace Co.
    - c. "Pozzolith 555A" - Master Builders
- G. Retarding Admixture: ASTM C494, Type D.
  - 1. Subject to compliance with requirements, use one of the following:
    - a. "Eucon Retarder 75" - Euclid Chemical Co.
    - b. "Daratard" - W. R. Grace Co.
    - c. "LL 880" - Master Builders
- H. Use of admixtures will not relax cold weather placement requirements.

2.4 PATCHING GROUT

- A. Portland cement, water, and fine sand passing a No. 30 mesh sieve.
- B. SikagROUT 212 and Sikadur 32 Ni-Mod Manufactured by Sika Corporation, 875 Valley Brooks Avenue, Lyndhurst, NJ 07071, Ph (201) 933-8800 or approved equal.

2.5 NONSHRINK GROUT

- A. Masterflow 928, manufactured by Master Builders, Inc., Construction Products Division, 23700 Chagrin Blvd., Cleveland, OH 44122, Ph (216) 831-5500, or approved equal.

2.6 FLOOR SLEEVES

- A. PVC Schedule 40 pressure pipe or hot dipped galvanized pipe sleeves, two pipe sizes larger than carrier pipe, unless otherwise noted on the Drawings.

2.7 OTHER EMBEDDED ITEMS

- A. Items encased in concrete shall not be painted.

2.8 BONDING AGENT

- A. Two component liquid epoxy bonding agent.
  - 1. Subject to compliance with requirements, use one of the following:
    - a. "Sikadur 32" - SIKA
    - b. "Resi-Bond" - Dayton Superior
    - c. "Concresive LPL" - Master Builders

2.9 CURING MATERIALS

- A. Curing compound or material shall be compatible with required finishes and/or coatings.
- B. Sheet Materials: ASTM D 4397, 4-mil polyethylene film or waterproof paper.
- C. Spray Applied Membrane Forming Liquids (applied in accordance with ACI 301):
  - 1. Subject to compliance with requirements, use one of the following:
    - a. "Kure-N-Seal" - Sonneborn
    - b. "Day-Chem Cure & Seal" - Dayton Superior
    - c. "Masterkure" - Master Builders
- D. Moisture cure walls where curing compound or material are incompatible with required finishes and/or coating.
- E. Water: Clean and not detrimental to concrete.

2.10 FLOOR HARDENER AND SEALER

- A. Floor Sealer/Hardener: Waterborne, transparent silicate compound. Sonneborn Kure-N-Hardener by Sonneborn Building Products, ChemRec, Inc., 7711 Computer Ave., Minneapolis, MN, 55435, Ph (800) 433-9517 or approved equal.

#### 2.11 ANCHORING SYSTEMS

- A. Anchor Bolts: ASTM A307 Grade 36 headed type unless otherwise indicated.
- B. Hilti HIT HY 150 Injection Adhesive Anchor by Hilti Fastening Systems, P.O. Box 21148, Tulsa, OK 74121, Ph (800) 879-8000 or approved equal.
- C. Hilti Kwik Bolt II by Hilti Fastening Systems or approved equal.

#### 2.12 EXPANSION JOINT FILLERS

- A. Preformed material conforming to the requirements of ASTM D1751. Size: 1/2" by depth of slab minus 1/2 inch or as indicated on the drawings.

### PART 3 - EXECUTION

#### 3.0 FORMWORK

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are correct size, shape, alignment, elevation and position. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
- B. Arrange formwork construction to allow for proper sequencing and removal without damage. Use orderly and symmetrical panel arrangement with minimum number of joints. Mount panels on rigid supports to minimize deflection. Before proceeding, secure approval of formwork and procedures.
- C. Forms:
  - 1. Sufficiently tight to prevent loss of mortar.
  - 2. Seal wood with coating material to minimize absorption of moisture from the concrete.
  - 3. Coat textured forms with release agent and others where required. Application shall be prior to reinforcement placement.
  - 4. Coat steel forms with a non-staining, rust-preventive form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.
- D. Thoroughly remove all dirt, mortar, ice and foreign matter before each use. Where the bottom of the form is inaccessible from within, access panels shall be provided to permit thorough removal of extraneous material before placing concrete.
- E. Chamfer all exposed horizontal and vertical edges or outer corners 3/4 inch, both interior and exterior of structures, except where other construction contacts the concrete.
- F. Where tolerances are not stated elsewhere in these specifications or drawings for any individual

structure or feature, permissible deviations from established lines, grades, and dimensions are listed below:

1. Variation from the Plumb:
  - a. In the lines and surfaces of columns, walls, and in arises: In 10 feet, 1/4-inch; in any story or 20 feet maximum, 3/8-inch; in 40 feet or more, 3/4-inch.
  - b. For exposed corners, control-joints and other conspicuous lines: In any bay or 20 feet maximum 1/4-inch; in 40 feet or more, 2-inch.
2. Variation from the Level or from the grades shown:
  - a. In Top of Walls: In 10 feet, 1/4-inch; in any bay or 20 feet maximum, 3/8-inch; in 40 feet or more, 3/4-inch.
  - b. For exposed horizontal grooves and other conspicuous lines: In any bay or 20 feet maximum, 1/4-inch; in 40 feet or more, 2-inch.
3. Variation of the linear building lines from established position in plan and related position of walls and partitions: in any bay or 20 feet maximum, 1/4-inch; in 40 feet or more, 2-inch.
4. Variation in the sizes and locations of sleeves, floor openings and wall openings: 1/4-inch.
5. Variation of cross-sectional dimensions in the thickness of slabs and walls: Minus, 1/4-inch; plus, 1/2-inch.
6. Variation from established lines and grades in sidewalks, plazas, outdoor concrete slabs, curb and gutter sections: in 10 feet, 1/4-inch; in 1 foot, 1/8-inch.

### 3.1 REINFORCEMENT

- A. Design: The reinforcement design shown on drawings shows only the necessary information for detailing the reinforcement and preparing placing and bending details.
- B. Bending: In accordance with CRSI Manual of Standard Practice, Chapter 7.
- C. Placement: Place reinforcement accurately as shown. Adequately secure metal reinforcement in position by concrete or metal chairs and spacers, in accordance with CRSI Manual of Standard Practice. Distance between the steel and the surface, as shown; otherwise, in accordance with the CRSI Manual. In walls, use bolsters or chairs between form and reinforcement to prevent lateral displacement of reinforcement and to ensure proper concrete cover.
- D. Placing bars in fresh concrete as the Work progresses (“stabbing”), and adjusting bars during the placement of concrete shall not be permitted.
- E. Splices:
  1. Bar laps shall be in contact and securely tied.
  2. Locate splices of reinforcement as shown. For any splices not shown, provide splice length as called for on the Drawings and in accordance with ACI 318.
  3. In beams and slabs, all top bars shall be spliced at mid-span and all bottom bars shall be spliced at supports.
- F. Reinforcement shall be continuous around corners.
- G. Bars shall not be field bent or cut unless otherwise approved by the owner. Bars shall not be bent or straightened in a manner that will damage the bars. The use of heat to bend or straighten bars shall not be permitted.

- H. Tack welding of reinforcing bars is not permitted without written permission of the owner.
- I. Inspection: After reinforcement has been placed, it shall be inspected by the owner or the owner's representative prior to placing the concrete.
- J. Condition of Surfaces: At time concrete is placed, all metal reinforcement shall be free from rust, scale, frost, or other coatings that would destroy or reduce the bond.

### 3.2 JOINTS AND EMBEDDED ITEMS

- A. Construct all joints true to line with faces perpendicular to surface.
- B. Construction Joints: Locate and install construction joints where shown.
  - 1. Obtain approval for joints not shown and locate them where they least impair the strength of the structure. Make joints perpendicular to the main reinforcement.
  - 2. Continue all reinforcing steel across construction joints.
  - 3. Use bonding agent at joints between fresh concrete and existing or fully cured, hardened concrete. Clean surfaces of laitance, coatings, loose particles, and foreign matter. Apply bonding agent in accordance with manufacturer's instructions.
- C. Control Joints: Provide hand tooled, saw-cut, or formed control joints in slabs on grade in patterns shown on the Drawings. Provide continuous control joints. In no case shall distance between joints, exceed 15'-0". Provide depth of control joint equal 1/4 slab thickness unless indicated otherwise.
- D. Expansion Joints: Install expansion joint fillers as shown on Drawings. Separate slabs, curbs, manholes, and inlets from vertical surfaces with expansion joint material. Extend full depth of joint, and not less than 1/2 inch, nor more than 1 inch below finished surface where sealants are indicated.
- F. Other Embedded Items, Penetrations, and Block-outs:
  - 1. Before concreting, place all required sleeves, inserts, anchor bolts, and embedded items. Anchor to prevent floatation and displacement.
  - 2. Give all trades whose work is related to the concrete ample notice and opportunity to introduce embedded items before concrete is placed.
  - 3. Position embedded items accurately and support them against displacement. Fill voids in leaves, and inserts, and anchor slots temporarily with readily removable material to prevent the entry of concrete.

### 3.3 MIXING (READY-MIX CONCRETE)

- A. When the concrete is mixed completely in a truck mixer, 70 to 100 revolutions at the mixing speed specified by the manufacturer are required to produce uniformity of the concrete.

### 3.4 PLACING OF CONCRETE

- A. Preparation Before Placing:
  - 1. Remove hardened concrete and foreign materials from inner surfaces of conveying

- equipment.
2. Check formwork for completion, check position and securing of reinforcement, joint material, sleeves, anchors, and other embedded items, and obtain approval on entire preparation.
  3. Remove ice and excess water and sprinkle semi-porous sub-grades sufficiently to eliminate suction.
  4. Do not place concrete on frozen ground.
  5. Do not place concrete during rain, sleet, or snow unless protection is provided.
- B. Depositing:
1. Place concrete in final position to avoid segregation due to re-handling or flowing. Spread concrete in horizontal layers and do not drop more than 5 feet without using drop chutes. Place concrete at such a rate that the concrete remains plastic and flows readily into spaces between bars. Do not deposit concrete that has partially hardened or become contaminated by foreign material. Lifts shall be kept between 6 inches and 20 inches high and shall be of a height to minimize surface defects and eliminate rock pockets and cold joints.
  2. Deposit concrete continuously and rapidly enough so that the layer supporting the one being placed is still plastic. If continuous placement is impossible, locate construction joints where shown or as approved.
  3. Remove temporary form spreaders when concrete reaches them.
  4. Do not begin placing concrete in supported elements until the concrete previously placed in beams and walls has cured a minimum of one day.
- C. Compacting:
1. Use high frequency vibrators in the placement of concrete forms. When concrete is being placed on hardened concrete or in bottom of forms, exercise care to ensure complete consolidation. After the initial lift, vibrator shall penetrate through and into top of previous lift of concrete.
  2. Internal vibrators shall have a minimum frequency of 8,000 rpm. Over-vibrating and use of vibrators to transport concrete within forms shall not be allowed. Insert and withdraw vibrators at many points, from 18 to 30 inches apart, for 5- to 15-second duration. Keep a spare vibrator on the project site during all concrete placing operations.
  3. Once concreting is started, it shall be carried on as a continuous operation until the placing of the panel or section is completed, preventing fresh concrete from being deposited on concrete which has hardened sufficiently to cause formation of seams and planes of weakness within the section.
  4. Remove splashes or accumulations of hardened or partially hardened concrete or mortar on forms or reinforcement above general level of the concrete already in place before the work proceeds.
  5. Maintain reinforcement in proper position during concrete placement operations.
  6. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surfaces free of lumps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

### 3.5 SHORES AND SUPPORTS

- A. Comply with ACI 347 for shoring and re-shoring. Contractor will be fully responsible for the design, construction, and performance of shoring and re-shoring.

### 3.6 FORM REMOVAL

- A. Carefully remove forms to ensure the complete safety of the structure. Vertical forms of walls may be removed after 24 hours, providing the concrete will not be injured. All supporting forms shall remain in place for a minimum of 14 days and until concrete has obtained design minimum compressive strength. Do not remove supporting forms or shoring until members have acquired sufficient strength to support their weight and imposed loads safely.

### 3.7 REPAIRING AND PATCHING

- A. Patch all the tie holes and all repairable defective areas immediately after form removal.
- B. All honeycombed and other defective concrete shall be removed to sound concrete with edges perpendicular to the surface. Dampen the area to be patched and an area at least 6 inches wide surrounding it to prevent absorption of water from the patching grout. Mix bonding agent to the consistency of thick cream and brush it well into the surface.
- C. Make the patching grout of the same material and approximately the same portions as used for the concrete, omitting the coarse aggregate. The resultant grout shall consist of not more than 1 part cement to 2-1/2 parts sand by damp loose volume.
- D. Do not use more mixing water than necessary for handling and placing. Mix the patching grout in advance and allow to stand with frequent manipulation with a trowel, without adding water, until it has reached the stiffest consistency that will permit placing.
- E. When the bonding agent begins to lose the water sheen, apply the premixed patching grout. The grout shall be thoroughly consolidated into place and struck off to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave the patch undisturbed for at least 1 hour before finishing it. Keep the patched area damp for 7 days. Do not use metal tools in finishing a patch in a formed wall that will be exposed.
- F. Tie holes: Clean and thoroughly dampen, then fill solid with patching grout.

### 3.8 FINISHES FOR FORMED SURFACES

- A. Rough Form Finish: Leave surface with texture imparted by the forms on concrete below finished grade.
- B. Smooth Form Finish: On concrete above finished grade and exterior concrete exposed to view, completely remove all fins. All form marks should be ground flush so that the concrete surface is smooth.
- C. Related Unformed Surfaces: At top of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.
- D. Protect concrete from damage until completion of concrete sealing.

### 3.9 SLABS

- A. Screeding: After concrete has been thoroughly consolidated, screed slabs to the desired elevation and contours by means of accurately placed edge forms and intermediate screed strips.
- B. Jointing: Locate and construct control joints as shown.
- C. Floated Finish: Apply float finish to all interior slab surfaces to receive trowel finish as indicated on Architectural Drawings.
  - 1. Place, consolidate, strike off, and level concrete, but do not work it further until ready for floating. Begin floating when water sheen has disappeared and when the surface has stiffened sufficiently.
  - 2. During or after the first floating, check planeness of surface with a 10-foot straightedge applied at not less than two different angles, and then cut down all high spots and fill all low spots to achieve a true plane within 1/4 inch in 10 feet.
  - 3. Refloat slab immediately to a uniform sandy texture.
- D. Troweled Finish: Apply trowel finish to all interior slab surfaces as indicated on Architectural Drawings.
  - 1. Float finish slab as described above, then steel trowel by machine or by hand. Additional troweling shall be done by hand after the surface has hardened sufficiently. Final troweling shall produce a ringing sound from the trowel and the finish surface shall be free of trowel marks and uniform in texture.
- E. Broom Finish: Immediately after floating, give slabs for exterior stoops a coarse, transverse-scored texture by drawing a broom across the surface perpendicular to line of traffic. Broom-finish all exterior slab in pattern shown on Drawings.
- F. Depress all floor drains one inch, taper the one inch depression over a two foot radius, unless indicated otherwise.

### 3.10 FLOOR SEALER/HARDENER

- A. Interior floors as indicated on Architectural Drawings shall receive sealer/hardener in accordance with the manufacturer's recommendations.
- B. Apply one coat of sealer/hardener after floors have cured and after final cleaning. Mix and apply in accordance with the manufacturer's recommendations.

### 3.11 CURING AND PROTECTION

- A. General: Beginning immediately after placement, protect concrete from drying, excessively hot or cold temperatures, and mechanical injury. Keep moisture loss to a minimum until cement has hydrated and concrete is cured.
- B. Curing:
  - 1. Formed Surfaces: Keep forms wet. Cool metal forms exposed to the sun with water. Forms



shall remain in place for 7 days unless a curing method as specified below is used.

2. Duration of Curing: 7 days minimum.
3. Methods of curing shall be as follows:
  - a. Provide moisture-retaining cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practical width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  - b. Provide water curing as follows: Keep concrete surface continuously wet by covering with water, or continuous water-fog spray. Cover concrete surface with absorptive cover, thoroughly saturate cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
  - c. Provide Liquid Membrane Forming Curing Compound as follows: Apply specified curing and sealing compound to concrete surfaces as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period. Use Liquid Membrane Curing Compound only as approved by the owner.
  - d. The selected curing method shall be applied to the concrete immediately upon removal of forms.

C. Protection:

1. In cold weather, maintain the moisture conditions but also, by heating or covering, maintain temperature of the concrete between 50° F and 70° F for entire curing period.
2. In hot weather, take immediate steps to protect newly finished concrete from the drying effects of wind and sun, and maintain temperature of the air surrounding the concrete uniform within 5° F in any one hour or 50° F in any 24-hour period.
3. During curing period, protect concrete from mechanical damage, loading, shock, and vibration.

3.12 CONSTRUCTION OF EQUIPMENT PADS AND CONCRETE FILL

- A. Refer to Architectural, Civil, Mechanical, Electrical, and any Specialty Drawings for equipment pads not shown on structural drawings.
- B. Equipment pads and concrete fill shall be placed as soon as possible after completion of the curing period of the walls and floor. Contact surfaces shall be thoroughly cleaned to the degree recommended by the bonding agent manufacturer.
- C. Bonding agent shall be accurately and thoroughly mixed and applied at the manufacturer's recommended coverage rate. Mix only the amount which can be used prior to expiration of the pot life. Concrete shall be immediately placed over the fresh surface before setting of the agent. Bonding agent which sets up prior to placing concrete shall be recoated with a fresh coat.
- D. Equipment pads and concrete fill shall be accurately screeded to the elevations shown and steel trowel finished. Cure concrete as specified above. Set equipment anchor bolts at correct elevations in pad to accommodate equipment furnished.

3.13 NONSHRINK GROUT

- A. Use non-shrink grout to fill sleeves and voids under equipment and column bases. Grout shall be mixed and used in accordance with manufacturer's recommendations. Exposed edges shall be smooth, straight, and even.

3.14 DAMAGED OR DEFECTIVE CONCRETE

- A. Remove damaged or defective concrete before completion and acceptance of the work and replace with acceptable concrete.

END OF SECTION 03 30 00

## PART 1 - GENERAL

### 1.01 SUMMARY

A. Section Includes: Portland cement based manufactured stone veneer and trim.

B. Related Sections:

1. **06 10 00 - Wall Framing.**
2. **06 16 00 Wall Sheathing.**
3. **07 62 00–Flashing and Sheet Metal.**
4. **07 92 00–Joint Sealants.**

### 1.02 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI A118.4 – Specifications for Latex-Portland Cement Mortar.

B. American Society for Testing and Materials (ASTM):

1. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
2. ASTM C 67 – Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
3. ASTM C 144 – Standard Specification for Aggregate for Masonry Mortar.
4. ASTM C 177 – Standard Test Method for Steady-State Head Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
5. ASTM C 207 – Standard Specification for Hydrated Lime for Masonry Purposes.
6. ASTM C 270 – Standard Specification for Mortar for Unit Masonry.
7. ASTM C 482 – Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement.
8. ASTM C 567 – Standard Test Method for Determining Density of Structural Lightweight Concrete.
9. ASTM C 847 – Standard Specification for Metal Lath.
10. ASTM C 932 – Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering.
11. ASTM C 979 – Standard Specification for Pigments for Integrally Colored Concrete.
12. ASTM C 1032 – Standard Specification for Woven Wire Plaster Base.
13. ASTM C 1059 – Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.
14. ASTM D 226 – Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
15. ASTM C1063 – Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster
16. ASTM C1329 – Standard specification for Portland cement

17. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
18. ASTM C1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
19. ASTM E2556/E2556M – Standard Specification for Vapor Permeable Flexible Sheet Water-Resistive Barriers Intended for Mechanical Attachment

C. Other Standards:

1. UBC Standard No. 14-1, Kraft Waterproof Building Paper
2. ICC AC38 Acceptance Criteria for Water Resistive Barriers
3. UU-B-790 Building Paper, Vegetable Based, Kraft, waterproofed, water repellent and fireproof

D. International Code Council (ICC):

1. ESR Report.

E. Underwriter’s Laboratory (UL): Building Materials Directory.

1.03 SUBMITTALS

A. Reference Section 01 33 00–Submittal Procedures; submit following items:

1. Product Data.
2. Samples:
  - a. Standard sample board consisting of small-scale pieces of veneer units showing full range of textures and colors.
  - b. Full range of mortar colors.**
3. **Verification Samples: Following initial sample selection submit “laid-up” sample board using the selected stone and mortar materials and showing the full range of colors expected in the finished Work; minimum sample size: 3 by 3 feet (1 by 1 m).**
4. Quality Assurance/Control Submittals:
  - a. Qualifications:
    - 1) Proof of manufacturer qualifications.
    - 2) Proof of installer qualifications.
  - b. Regulatory Requirements: Evaluation reports.
  - c. Veneer manufacturer’s installation instructions.
  - d. Installation instructions for other materials

## WINDOW ROCK OFFICE BUILDING & SITE

B. Closeout Submittals: Reference Section 01 78 00-Closeout Submittals; submit following items:

1. Maintenance Instructions.
2. Special Warranties.

### 1.04 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer Qualifications: Eldorado Stone, LLC.
2. Installer Qualifications: Experienced mason familiar with installation procedures and related local, state and federal codes masonry.

B. Certifications:

1. **ICC Evaluation Service - Evaluation Report ESR-1215**
2. **ICC ESR-1215, Florida Building Code Supplement**
3. **ASTM C1670**
4. **LARR – Research Report RR25589**
5. **HUD - Material Release Number 910F**
6. **UL - Classification listing in Building Materials Directory: UL 546T (F8002)**

C. Field Sample:

1. Prepare 4 by 4 foot ( 1200 by 1200 mm) sample at a location on the structure as selected by the Architect. Use approved selection sample materials and colors. Include section of corner and transition to EIFS.
2. Obtain Architect's approval.
3. Protect and retain sample as a basis for approval of completed manufactured stone work. Approved sample may be incorporated into completed work.

### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Reference Section 01 66 00-Product Storage and Handling Requirements.

B. Follow manufacturer's instructions.

### 1.06 PROJECT/SITE CONDITIONS

A. Environmental Requirements: When air temperature is 40 degrees F (4.5 degrees C) or below, consult local building code for Cold-Weather Construction requirements.

### 1.07 WARRANTY

A. Special Warranty: Manufacturer's standard warranty coverage against defects in materials when installed in accordance with manufacturer's installation instructions.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURER

A. Eldorado Stone, LLC  
1370 Grand Ave., Bldg. B  
San Marcos, CA 92069

Tel: (800) 925-1491  
Fax: (760) 736-3840  
E-Mail: [customerservice@eldoradostone.com](mailto:customerservice@eldoradostone.com)  
Website: [www.eldoradostone.com](http://www.eldoradostone.com)

1. Manufacturer's Distributor:

B. Product: Cambria Cliffstone veneer.

C. Substitutions: None Allowed.

### 2.02 MATERIALS

#### A. Stone Veneer:

1. Profile: Cliffstone - Cambria . Include matching corner pieces.

2. Stone Accents: None .

a. Color: -----.

b. Texture----- .

- B. Veneer Unit properties: Precast veneer units consisting of portland cement, lightweight aggregates, and mineral oxide pigments.
  - 1. Compressive Strength: ASTM C 192 and ASTM C 39, 5 sample average: greater than 1,800 psi (12.4MPa).
  - 2. Shear Bond: ASTM C 482: 50 psi (345kPa), minimum.
  - 3. Freeze-Thaw Test: ASTM C 67: Less than 3 percent weight loss and no disintegration.
  - 4. Thermal Resistance: ASTM C 177: 0.473 at 1.387 inches thick
  - 5. Weight per square foot: 2012 IBC and 2012 IRC, ASTM C1670, 15 pounds, saturated.
- C. Weather Barrier: ASTM D 226, Type 1, No. 15, non-perforated asphalt-saturated felt paper or ICC AC-38, synthetic house wrap
- D. Reinforcing: ASTM C 847, 2.5lb/yd<sup>2</sup> (1.4kg/m<sup>2</sup>) galvanized expanded metal complying with code agency requirements for the type of substrate over which stone veneer is installed.
- E. Mortar:
  - 1. Cement: Portland cement complying with ASTM C 1329.
  - 2. Lime: ASTM C 207.
  - 3. Sand: ASTM C 144, natural or manufactured sand.
  - 4. **Color Pigment: ASTM C 979, mineral oxide pigments.**
  - 5. Water: Potable.
  - 6. Pre-Packaged Latex-Portland Cement Mortar: ANSI A118.4.
- G. Bonding Agent: Exterior integral bonding agent meeting ASTM C 932
- H. **Water Repellent: Water based silane or siloxane masonry water repellent**

## 2.03 MORTAR MIXES

- A. Standard Installation (Grouted Joints):
  - 1. Mix mortar in accordance with ASTM C 270,
  - 2. Polymer modified mortar complying with ANSI A118.4
    - a. **Add color pigment in grout joint mortar in accordance with pigment manufacturer's instructions not to exceed 10% by weight of cement.**

### **PART 3 - EXECUTION**

#### 3.01 EXAMINATION

- A. Examine substrates upon which work will be installed.
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.
- C. Commencement of work by installer is acceptance of substrate.

#### 3.02 PREPARATION

- A. Protection: Protect adjacent work from contact with mortar.
- B. Surface Preparation: Prepare substrate in accordance with manufacturer's installation instructions for the type of substrate being covered.

#### 3.03 INSTALLATION

- A. Install and clean stone in accordance with manufacturer's installation instructions for Standard Installation (Grouted Joint) or Jointless/Dry-Stacked installation as specified above.
- B. Apply repellent in accordance with repellent manufacturer's application instructions.**

#### 3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Manufacturer's Field Service Representative shall make two periodic site visits review of on-going installation process but is not responsible for any errors or omissions that are not observed or are previously completed.**

#### 3.05 CLEANING

- A. Reference Section 01 74 00–Cleaning and Waste Management.
- B. Remove protective coverings from adjacent work.
- C. Cleaning Veneer Units:
  - 1. Wash with soft bristle brush and water/granulated detergent solution
  - 2. Rinse immediately with clean water
- D. Removing Efflorescence:
  - 1. Allow veneer to dry thoroughly
  - 2. Scrub with soft bristle brush and clean water
  - 3. Rinse immediately with clean water; allow to dry
  - 4. If efflorescence is still visible, contact ES Customer Service for assistance

END OF SECTION  
04 73 00



## SECTION 05 12 00 - STRUCTURAL STEEL

### PART 1 - GENERAL

#### 1.0 DESCRIPTION

- A. The work of this section consists of furnishing, installing, and connecting all structural steel members, complete with required studs, braces, connection plates, welds, washers, bolts, nuts, shims, anchor bolts, templates, field welding and adjusting for plumb and level.
- B. Products Furnished but Not Installed Under this Section: Anchor Bolts, Bearing Plates, Angles, etc.
- C. Related Requirements:
  - 1. Section 03 30 00: Cast-in-Place Concrete.
  - 2. Section 06 10 00: Rough Carpentry

#### 1.1 REFERENCES

- A. Design, Detailing, Fabrication and Erection: Meet requirements of AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Building", and AISC "Code of Standard Practice for Steel Buildings and Bridges", latest editions.
- B. AISC "Code of Standard Practice for Steel Building and Bridges".
- C. AWS D1.1 Structural Welding Code - Steel.
- D. ASTM A36 - Standard Specification for Carbon Structural Steel.
- E. ASTM A123 - Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
- F. ASTM A325 - Standard Specifications for Structural Bolts, Steel, Heat-Treated.
- G. ASTM A500 - Standard Specifications for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- H. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength

#### 1.2 QUALITY ASSURANCE

- A. Fabricator Qualifications: Minimum three years experience in fabrication of structural steel for similar projects.
- B. Welder Qualifications: Currently qualified according to AWS D1.1 to perform the welds specified..

- C. Testing of steel shall be the responsibility of the Contractor, at the Contractor's expense. An Independent Testing Agency will be required to inspect field welding. Shop welding at the fabrication plant will be part of the Contractor and Subcontractor QC plan.
- D. Special Inspection: Special Inspection is required as per the requirements set forth in the International Building Code (IBC) 2012, Section 17.

### 1.3 SUBMITTALS

- A. Shop Drawings:
  - 1. All shop drawings shall be original drawings and shall not be reproductions of the contract documents.
  - 2. Clearly indicate profiles, sizes, and locations of structural members, connections, attachments, studs, anchorages, framed openings, size and type of fasteners, cambers and clearances. Indicate welded connections using standard AWS welding symbols. Clearly indicate net weld lengths, sizes and welding sequences.
  - 3. Submit complete Shop Drawings including detail drawings and erection drawings for structural steel. Include information on location, type, and size of bolts and welds, distinguishing between those made in the shop and those made in the field.
    - a. Indicate weld lengths and sizes using standard AWS welding symbols
    - b. Include setting drawings and templates for anchorages to be installed as work of other sections.
    - c. Detail drawings shall indicate steel members and parts of steel members which are to receive no paint.
    - d. Detail drawings shall show complete details and schedules for fabrication and shop assembly of members including profiles, sizes, steel yield strengths, spacing, location, connections, fasteners, and cambers.
    - e. Beam and column mark numbers shall be cross-referenced to the corresponding erection plan and to the column grid location.
    - f. Detail drawing shall show the name of the shop paint.
- B. Quality Control Submittals:
  - 1. Design Data: Submit design calculations, bearing the seal and signature of a professional engineer, employed by the Contractor and registered in the State of Utah for the following:
    - a. Connections not completely detailed on the structural drawings.
    - b. Requests for substitution of member sizes or material grades.
  - 2. Certificates:
    - a. Welder Qualifications: Submit copies of welder's certifications on request.

### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Materials to be installed by Others:
  - 1. Deliver anchor bolts and other anchorage devices which are embedded in cast-in-place concrete construction to project site in time to be installed before start of cast-in-place concrete operations.
  - 2. Provide setting drawings, templates and directions for installation of anchor bolts and other devices.

B. Delivery and Storage

1. Steel: Store members above ground on platforms, skids or other supports and stored upright to prevent twisting. Protect steel from corrosion.
2. Other Materials: Store in a weather-tight and dry place, until ready for use. Store packaged materials in their original unbroken package or containers.

PART 2 - PRODUCTS

2.0 MATERIALS

- A. Bars and Plates: ASTM A36.
- B. Steel Tube: ASTM A500. Grade B.
- C. Bolts:
  1. Anchor Bolts: ASTM A307.
- D. Filler Metal for Welding: Meet requirements of AWS D1.1, 70 series.

2.1 FABRICATION

- A. General: Fabricate structural steel in accordance with AISC specifications.
- B. Shop Painting:
  1. Surface Preparation: After fabrication and shop assembly, clean off all loose rust, mill scale, weld spatter, slag, or flux deposits in accordance with SSPC procedures as follows:
    - a. Surfaces to be Concealed in the Completed Structure: SP-3 power tool cleaning.
    - b. Surfaces to be Exposed in the Completed Structure: SP-6 commercial blast cleaning.
  2. Painting: Shop coat fabricated items with shop paint. Omit shop paint on parts to be galvanized, surfaces to be encased in concrete, surfaces to be welded, and surfaces to receive welded studs.
- C. Marking: Mark members in protected plainly visible locations in accordance with reference numbers on setting diagrams.
- D. Finished Work: Finish work in accordance with accepted shop drawings.
  1. Work: True and free from twists, kinks, buckles, open joints and other defects.
- E. Welding: Comply with AISC Specifications and AWS D1.1. Welds not specified shall be 3/16-inch continuous fillet weld but not less than AISC minimum based on thickness of parts joined.
- F. Splices: Splicing of members to obtain required lengths not allowed without prior written approval of the owner, or unless indicated on drawings.
- G. Substitutions: Where exact sizes and weights called for are not readily available, secure

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

owner's acceptance of suitable sizes in time to prevent any delay due to such substitutions.

## 2.2 ANCHORS

- A. Provide anchors, as indicated on drawings and required. Locate as indicated on accepted shop drawings.
- B. Anchor Bolts: ASTM A307 with suitable nuts and plain washers. Size and length as shown on drawings, headed unless otherwise shown. J- or L-shaped anchors shall not be used.

## PART 3 - EXECUTION

### 3.0 EXAMINATION

- A. Embeds: Prior to start of erection of steel, the Contractor shall check location of embedded anchor bolts and report deviations from anchor bolts setting plan to owner in writing. Do not proceed until all unacceptable conditions are corrected.

### 3.1 PREPARATION

- A. Protection: Protect adjacent materials or areas below from damage due to weld spatter or sparks during field welding.
- B. Shoring and Bracing: Provide temporary shoring and bracing as required to maintain work in safe and stable condition during erection. Provide temporary guy lines as required to properly align members before welding. Contractor will be fully responsible for the design, construction, and performance of the shoring and bracing.
- C. Field Measurements: The Contractor shall take measurements on site as required for correct fabrication and installation. The Contractor shall be responsible for errors in fabrication and for correct fit of structural steel.

### 3.2 ERECTION

- A. General: Erect structural steel in accordance with AISC specifications with additional requirements of this section.
- B. Field Assembly: Assemble structural steel to lines and elevations indicated within specified erection tolerances.
- C. Field Modifications:
  - 1. The Contractor shall be responsible for errors in fabrication and for correct fit in field.
  - 2. Do not correct serious defects in field but call to the attention of the owner for decision as to method or procedure for correcting.
  - 3. Use of a cutting torch for field modification or re-fabrication of structural steel shall not be allowed without written acceptance of the owner.

### 3.3 QUALITY CONTROL TESTING DURING CONSTRUCTION

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

- A. An Independent Testing Agency shall be employed for Quality control Inspection: They shall perform their duties in such way that neither fabrication nor erection is unnecessarily delayed or impeded. The Inspector will not recommend or prescribe method of repair of defect.
  
- B. Inspection:
  - 1. Field examination of erected steel for alignment.
  - 2. Welding and Materials:
    - a. Inspection of welding shall assure that work conforms to specified requirements and shall include:
      - 1) Ascertaining that electrodes used for manual shielded metal arc welding and electrodes and flux used for submerged arc welding conform to requirements of this section.
      - 2) Ascertaining that specified welding procedure and specified welding sequence are followed without deviation, unless specific acceptance for change is obtained from the owner.
    - b. The Testing Agency shall perform the following tests in the fabricator shop:
      - 1) All Welds: 100% visual.
      - 2) All Full Penetration Welds: 100% ultrasonic.
    - c. The Testing Agency will perform the following tests of field welds:
      - 1) All Welds: 100% visual.
      - 2) Full Penetration Welds: 20% magnetic particle or ultrasonic.
    - d. When more than 10% of tested welds are rejected, all welds shall be tested using same method.
    - e. The Independent Testing Agency shall have authority to reject weldments. Such rejection may be based on visual inspection where in their opinion the weldment would not pass more detailed investigation.

END OF SECTION 05 12 00

## 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 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  - 2. Miscellaneous framing supports.
  - 3. Miscellaneous steel trim.
- B. Related Sections include the following:
  - 1. Division 9 Section "Painting" for field painting.

#### 1.3 DEFINITIONS

- A. Exterior: Defined as the following:
  - 1. Areas, locations, and surfaces that are unprotected, or exposed to environmental elements.
  - 2. Areas, locations and surfaces within uncontrolled environments.
  - 3. Areas, locations and surfaces of unconditioned spaces, including below grade/underground, partially-exposed, or "covered" parking areas.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation 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.

## 1.5 SUBMITTALS

- A. Product Data: For items specified.
- B. 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.
  - 2. Provide templates for anchors and bolts specified for installation under other Sections.

## 1.6 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. 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.
- B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal fabrications that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 1 year.
- B. Installer's Warranty: 1 year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS (SECTION NOT USED)

## 2.2 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.

## 2.3 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- D. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- E. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

## 2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Anchor Bolts: ASTM F 1554, Grade 36.
  - 1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
- C. Surface Preparation: SSPC-SP2 Hand Tool Clean and /or SSPC-SP3 Power Tool Clean.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.



## 2.6 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 true to line and level 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 and contour of welded surface matches that of adjacent surface.
- F. 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.
- 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.
  - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

## 2.7 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 retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

## 2.8 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

## 2.9 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
- C. Galvanize exterior miscellaneous steel trim and interior miscellaneous steel trim, where indicated.

## 2.10 (SECTION NOT USED)

## 2.11 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.

## 2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
  - 1. ASTM A 123, for galvanizing steel and iron products.
  - 2. ASTM A 153, for galvanizing steel and iron hardware.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
  - 1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
- D. Field Finish: Comply with Division 9 Section "Painting" for field painting.

## 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 bolts, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

### 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. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

## SECTION 06 10 00 - ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Wood blocking and nailers.
  - 2. Wood furring.
  - 3. Wood sleepers.
  - 4. Plywood sheathing.
  - 5. Plywood backing panels.
- B. Related Sections:
  - 1. Section 03 30 00: Cast-in-Place Concrete.
  - 2. Section 05 12 00: Structural Steel.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
  - 1. Wood-preservative-treated wood.
  - 2. Power-driven fasteners.
  - 3. Powder-actuated fasteners.
  - 4. Metal framing anchors.

### PART 2 - PRODUCTS

#### 2.1 WOOD PRODUCTS, GENERAL

- A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. 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. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Provide dressed lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

## 2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items 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 that 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 rough carpentry unless otherwise indicated.3

## 2.3 DIMENSION LUMBER FRAMING

A. Framing Other Than Non-Load-Bearing Interior Partitions: No. 2 grade.

1. Application: Framing other than interior partitions.
2. Species: Douglas fir-larch; WCLIB or WWPA.

B. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Application: Exposed exterior framing.
2. Species and Grade: As indicated above for load-bearing construction of same type.

## 2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Furring.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any

of the following species and grades:

1. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

## 2.5 PLYWOOD SHEATHING

- A. Refer to structural framing plans for all sheathing requirements.

## 2.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

## 2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: NES NER-272.
- C. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

## 2.8 METAL FRAMING ANCHORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. Simpson Strong-Tie Co., Inc.
  2. USP Structural Connectors.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of basis-of-design products.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates to which construction attaches or abuts, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of construction of the work of this section.
- B. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- C. Failure to call attention to defects or imperfections will be construed as acceptance and approval

of substrate conditions. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation and full responsibility for completed work.

### 3.2 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Install sheathing in accordance with APA.
- C. Not Applicable
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- F. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- G. Securely attach rough 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.

### 3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00



## SECTION 06 10 53 - 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 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Wood blocking, cants, and nailers.
  - 2. Plywood backing panels.
  - 3. Wood timber for exterior covered walkway and sun shades.
- B. Related Sections include the following:
  - 1. Division 6 Section "Sheathing."

#### 1.3 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. Not applicable
  - 3. Not applicable
  - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
  - 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
  - 1. Preservative-treated wood.
  - 2. Power-driven fasteners.
  - 3. Powder-actuated fasteners.
  - 4. Expansion anchors.
  - 5. Metal framing anchors.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air

circulation around stacks and under coverings.

- B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

## 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of miscellaneous carpentry that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
  - 2. Warranty Period: 1 year.
- B. Installer's Warranty: 1 year.

## 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. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
  - 3. 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.
  - 4. Provide dressed lumber, S4S, unless otherwise indicated.

### 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPAC2.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction.
  - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- 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.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

## 2.3 FIRE-RETARDANT-TREATED MATERIALS (not applicable)

## 2.4 DIMENSION LUMBER FRAMING

- A. Maximum Moisture Content: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness.
- B. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade of any species.

## 2.5 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous 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 Construction or No. 2 grade lumber.
- 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.
- D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

## 2.6 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

## 2.7 WOOD TIMBER

- A. Material: Suitable for exterior application.

## 2.8 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 with hot-dip zinc coating complying with ASTM A 153.
- 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: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

## 2.9 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cleveland Steel Specialty Co.
  - 2. Harlen Metal Products, Inc.
  - 3. KC Metals Products, Inc.
  - 4. Simpson Strong-Tie Co., Inc.
  - 5. Southeastern Metals Manufacturing Co., Inc.
  - 6. USP Structural Connectors.
  - 7. Or equal.
- B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 coating designation.
  - 1. Use for interior locations where stainless steel is not indicated.

## 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 "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.
- D. Do not splice structural members between supports, unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- F. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
  - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
  - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- thickness.
  - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
- G. 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.
- H. Comply with AWPA 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.
- I. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
  - 2. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's Uniform Building Code.
  - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2),

Window Rock Office Building and Site  
Construction Documents

- "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
4. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's International One- and Two-Family Dwelling Code.
- J. Use common wire 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; do not countersink nail heads, unless otherwise indicated.

END OF SECTION 061053

## SECTION 061600 - SHEATHING

### 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 the following:
  - 1. Wall sheathing.
  - 2. Building wrap.
  - 3. Sheathing joint-and-penetration treatment.
- B. Related Sections include the following:
  - 1. Division 6 Section "Miscellaneous Carpentry" for plywood backing panels.

#### 1.3 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. For building wrap, include data on air-/moisture-infiltration protection based on testing according to referenced standards.
- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
  - 1. Building wrap.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sheathing that fails in materials or workmanship within specified warranty period.

Window Rock Office Building and Site  
Construction Documents

1. Failures include, but are not limited to, the following:
    - a. Structural failures.
  2. Warranty Period: 2 years.
- B. Installer's Warranty: 1 year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Wood Structural Panel Sheathing:
1. LP.
  2. Boise Cascade.
  3. Or equal.
- B. Building Wrap: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. Tyvek – Commercial Wrap by DuPont. (Basis of Design)
  2. Dow Chemical Company.
  3. Raven Industries Inc.
  4. Reemay, Inc.
  5. Or equal.

### 2.2 WALL SHEATHING

- A. Wood Structural Panel Sheathing: Refer to structural drawings for specification.
1. Type and Thickness: Refer to structural plan.

### 2.3 BUILDING WRAP

- A. Product: Tyvek – Commercial Wrap by DuPont.
1. ASTM E 1677, Type I air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
    - a. Water-Vapor Permeance: Not more than 28 perms per ASTM E96 Method B.
    - b. Allowable UV Exposure Time: Not less than three months.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

### 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. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153.
- B. Power-Driven Fasteners: NES NER-272.
- C. Wood Screws: ASME B18.6.1.

## 2.5 WEATHER-RESISTANT SHEATHING PAPER

- A. Building Wrap:
  1. ASTM E 1677, Type I air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
    - a. Water-Vapor Permeance: Not more than 28 perms per ASTM E96 Method B.
    - b. Allowable UV Exposure Time: Not less than three months.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

## 2.6 (NOT USED)

## 2.7 MISCELLANEOUS MATERIALS

1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Securely attach to substrate by 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."
- D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### 3.2 WOOD SHEATHING INSTALLATION

- A. Comply with manufacturer's written instructions and structural drawings.
  - 1. Fasten wood sheathing to wood framing with screws.
  - 2. Install sheathing with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.

### 3.3 WEATHER-RESISTANT SHEATHING-PAPER INSTALLATION

- A. General: Cover sheathing with weather-resistant sheathing paper as follows:
  - 1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion or control-joint locations.
  - 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap, unless otherwise indicated.
- B. Building Wrap: Comply with manufacturer's written instructions.
  - 1. Seal seams, edges, fasteners, and penetrations with tape.
  - 2. Extend into jambs of openings and seal corners with tape.

### 3.4 SHEATHING JOINT-AND-PENETRATION TREATMENT

- A. Seal sheathing joints according to sheathing manufacturer's written instructions.
  - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient quantity of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
  - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

## SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

### 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 the following:
  - 1. Plastic-laminate cabinets and lockers.
  - 2. Quartz-surfacing-material countertops.

#### 1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 2. Show locations and sizes of cutouts and holes for plumbing fixtures and other items installed in architectural woodwork.
- C. Samples for Initial Selection: For each type of product indicated requiring product selection.
- D. Samples for Verification:
  - 1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
  - 2. Quartz-surfacing materials, 6 inches square.
  - 3. Corner pieces as follows:
    - a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
    - b. Miter joints for standing trim.
  - 4. Exposed cabinet hardware and accessories, one unit for each type and finish.

- a. Hardware samples will be returned up on approval.
- E. Product Certificates: For each type of product, signed by product manufacturer.
- F. Qualification Data: For Installer and fabricator.

#### 1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.
- C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
  - 2. Established Dimensions: Where field measurements cannot be made without delaying

the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

## 1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of interior architectural woodwork that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 2 years.
- B. Installer's Warranty: 1 year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. High-Pressure Decorative Laminate: Subject to compliance with requirements, provide high pressure decorative laminates by one of the following:
  - 1. Formica Corporation.
  - 2. Nevamar Company, LLC; Decorative Products Div.
  - 3. Wilsonart International; Div. of Premark International, Inc.
  - 4. Or equal.
- B. Quartz Surfacing Materials: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  - 1. Silestone by Consentino. (Basis of Design)
  - 2. Quartz surfacing by Caesarstone.
  - 3. Zodiaq by DuPont.
  - 4. Or equal.
- C. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
  - 1. Medex, Medex NC, Medite II, or Arreis SDF by SierraPine Ltd.
  - 2. Weyerhaeuser Company; Premier Plus by Weyerhaeuser.
  - 3. Or equal.
- D. Particleboard: ANSI A208.1, Grade made with binder containing no urea formaldehyde.
  - 1. Rodman Industries, Inc.
  - 2. Acadia Board Company.
  - 3. PrimeBoard, Inc.

4. Or equal.
- E. Cabinet hardware: Subject to compliance with requirements, provide products by one of the following manufacturers.
  1. Accuride.
  2. Hafele.
  3. Or equal.

## 2.2 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Core and Substrates: Comply with the following:
  1. Hardboard: AHA A135.4.
  2. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
  3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
- C. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
  1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.
- D. High-Pressure Decorative Laminate (HPDL): NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
- E. Quartz Surfacing Material:
  1. Composition: 93 percent crushed quartz aggregate combined with resins and pigments and fabricated into slabs using a vacuum vibro-compaction process.
  2. Performance:
    - a. Flexural Strength: 7,420 psi, ASTM C880.
    - b. Compressive Strength: ASTM C-170
      - 1) Dry: 10,430 psi average.
      - 2) Wet: 11,265 psi average.
    - c. Izod Impact Strength: 0.361ft. lbs./inch of notch average; ASTM D256.
    - d. Bond Strength: 205 psi; ASTM C482 modified.
    - e. Modulus of Rupture: 2,110 average, ASTM C99.
    - f. Mohs Hardness: 6.5-7.5; scratch test.
    - g. Absorption: 0.022%; ASTM C97.
    - h. Stain and Acid Resistance: Not affected; ASTM D2299.
    - i. Surface Burning Characteristics: Flame spread = 10, smoke density = 195; ASTM E84.
    - j. Thermal Shock Resistance: Passes 5 cycles, 75°F-295°F; ASTM C484.
    - k. Coefficient of Thermal Expansion: 1.36x10 inch per °F.; ASTM C531.
    - l. Weathering Resistance: Not affected after seven days in 1% sulfuric acid; ASTM C217.
    - m. Freeze-Thaw Resistance: No visible damage or discoloration after 25 cycles (-45°C to 23°C); S.L.P. with ASTM C62 as guide.

- n. Wear Resistance: 36.12 gram average; ASTM C501, tested with 1 kg. load, 1000 cycles at 70 r.p.m.

## 2.3 CABINET HARDWARE AND ACCESSORIES

- A. Adjustable Shelf Pilaster Standards: Side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
  - 1. Product: KV #255 by Knape & Vogt or equal.
    - a. 23 gauge high strength steel.
    - b. 39/64" wide x 11/64" deep.
    - c. BHMA Grade 1 approved.
    - d. Self supports: KV #256.
- B. Shelf Support Pins:
  - 1. Product: KV #330 by Knape & Vogt or equal.
    - a. Stainless steel.
    - b. Pin diameter for 5 mm hole (approx 13/64 inch).
- C. Grommets: Plastic, 2 inch diameter, locations as indicated. If locations are not indicated, as selected by Architect during shop drawing review. Doug Mockett, Sugatsune, Wood Technology, or equal.
- D. Drawer and Door Pulls: For all, including accessible casework.
  - 1. "U" shaped wire pull, aluminum with satin finish, 4 inch centers.
- E. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish to key with door hardware. All doors and drawers to be lockable.
- F. Hinges: Concealed (fully mortised) self-closing type, BHMA No. 652, steel with polished finish.
  - 1. Products: Blum or equal.
- G. Drawer Slides: BHMA A156.9, B05091.
  - 1. Heavy Duty (Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ballbearing slides. Model 3640 by Accuride or equal.

## 2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

- D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
  - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.5 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch Thick or Less: 1/16 inch.
  - 2. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  - 1. Notify Architect 7 days in advance of the dates and times woodwork fabrication will be complete.
  - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
  - 1. Seal edges of openings in countertops with a coat of varnish.

## 2.6 PLASTIC-LAMINATE CABINETS

- A. Construction Style: Frameless.
- B. Construction Type: Multiple self-supporting units rigidly joined together.
- C. Door and Drawer Front Style: Flush overlay.
- D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:



1. Horizontal Surfaces Other Than Tops: Grade HGS, 0.048 inches (1.2 mm) thick.
  2. Postformed Surfaces: Grade HGP.
  3. Vertical Surfaces: Grade HGS, 0.048 inches (1.2 mm) thick.
  4. Edges: Self-edge banded.
- E. Semi-Exposed Surfaces: Any of one of following.
1. Low pressure decorative polyester overlay.
  2. Low pressure decorative melamine overlay.
  3. HPL cabinet liner.
  4. Solid Phenolic core (SPC).
  5. Vinyl at cabinet backs and drawer bottoms only.
- F. Concealed Surfaces: Any of one of following.
1. Solid Wood or Plywood: Any hardwood or softwood species, with no defects affecting strength or utility. Hardwood and softwood lumber kiln dried to 7 and 10 percent moisture content, respectively.
  2. Particleboard: ANSI A208.1, Grade M-2.
  3. Medium-Density Fiberboard: ANSI A208.2.
  4. Solid Phenolic core (SPC).
- G. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As selected by Architect from laminate manufacturer's full range.

## 2.7 QUARTZ SURFACING-MATERIAL COUNTERTOPS

- A. Solid-Surfacing-Material Thickness: 3/4 inch.
- B. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid surfacing material complying with the following requirements:
1. As selected by Architect from manufacturer's full range.
- C. Fabricate tops indicated on Drawings. Comply with quartz surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
- D. Drill holes in countertops for plumbing fittings and soap dispensers in shop.
- E. Exposed Edges and Corners:
1. Countertops:
    - a. Edges and outside corners: As indicated on Drawings.
  2. Backsplash:
    - a. Edges: Square.
    - b. Outside Corners: Square butt joints.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

### 3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Maintain veneer sequence matching of cabinets with transparent finish.
  - 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
  - 1. Align adjacent Quartz-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
  - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 3. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
  - 4. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

- H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

## SECTION 068200 - FIBER REINFORCED PLASTIC PANELS

### 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. Section Includes:
  - 1. Fiber reinforced plastic panel system for adhesive mounting (W4 and W6-FRP).
  - 2. Moldings, adhesive, and joint sealants.

#### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- B. Selection Samples: For each finish specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- C. Maintenance Instructions.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

#### 1.5 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fiber reinforce plastic panels that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 2 years.
- B. Installer's Warranty: 1 year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Fiber Reinforced Plastic Panels: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  - 1. Fiber Reinforced Plastic (FRP) panels by Marlite (Basis of Design)
  - 2. Kemlite.
  - 3. Glasteel.
  - 4. Or equal.

### 2.2 PANEL SYSTEM

- A. Plastic Panel System: Factory finished panels, trim, sealant, and accessories.
- B. Panels: Marlite FRP Panels; fiberglass reinforced polyester, USDA approved for incidental food contact.
  - 1. Surface Burning Characteristics: Flame spread index of 200 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E 84 (Class C/III).
  - 2. Surface Texture: Gently pebbled, high-gloss.
  - 3. Color: As selected by Architect from full range.
  - 4. Thickness: 3/32 inch, nominal.
  - 5. Width: 48 inches.
  - 6. Height: 96 inches.
  - 7. Flexural Strength: 17,000 psi, when tested in accordance with ASTM D 790.
  - 8. Flexural Modulus: 600,000 psi, when tested in accordance with ASTM D 790.
  - 9. Tensile Strength: 8,000 psi, when tested in accordance with ASTM D 638.
  - 10. Tensile Modulus: 9,430 psi, when tested in accordance with ASTM D 638.
  - 11. Barcol Hardness: 40, when tested in accordance with ASTM D 2583.
  - 12. Impact Resistance: 7 ft-lb/in, when tested in accordance with ASTM D 256, Izod method.
  - 13. Coefficient of Thermal Expansion: 0.0000157 in/in/degree F, measured in accordance with ASTM D 696.
  - 14. Water Absorption: 0.17 percent, when tested in accordance with ASTM D 570.
  - 15. Specific Gravity: 1.53, when tested in accordance with ASTM D 792.
- C. Panel Trim: Extruded PVC, in manufacturer's standard colors.
  - 1. Outside corners, inside corners, edge trim, and division molding.

- D. Sealant: Marlite Silicone Sealant; gunnable silicone rubber; clear.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### 3.2 PREPARATION

- A. Take panels out of cartons and allow to acclimatize to room conditions for at least 48 hours prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Clean surfaces thoroughly prior to installation.
- D. Protect existing surfaces from damage due to installation.

#### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Use the adhesives recommended by the panel manufacturer unless prohibited by local regulations; obtain manufacturer's approval of alternative adhesives.
- C. Install continuous bead of silicone sealant in each joint and trim groove and between trim and adjacent construction, maintaining 1/8 inch expansion space.
- D. Avoid contamination of panel faces with adhesives, solvents, or cleaners; clean as necessary and replace if not possible to repair to original condition.
- E. Protect installed products until completion of project.
- F. Touch-up, repair or replace damaged products after Substantial Completion.

END OF SECTION 06 82 00

## SECTION 071910 - CONCRETE FLOOR SEALER

### 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 concrete sealer (F1-SCONC).

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each type of sealer and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.
- C. Manufacturer Certificates: Signed by manufacturers certifying that water repellents comply with requirements.
- D. Qualification Data: For Installer.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.
- F. Warranty: Special warranty specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

#### 1.5 PROJECT CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
  1. Ambient temperature is above 40 deg F.
  2. Concrete surfaces and mortar have cured for more than 28 days.
  3. Concrete or brick masonry walls are not treated prior to 30 days after building close-in.

4. Rain or snow is not predicted within 24 hours.
5. Application proceeds more than 24 hours after surfaces have been wet.
6. Substrate is not frozen, or surface temperature is above 40 deg F.
7. Windy conditions do not exist that may cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in Part 1 "Performance Requirements" Article within specified warranty period.
  1. Warranty Period: 2 years.
- B. Installer's Warranty: 1 year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Patching compound, cementitious, thin patching and skim-coating material, designed for reducing surface defects on interior floors. : Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  1. Degussa.
  2. ChemMasters.
  3. Or equal.
- B. Concrete Clear Sealer for protecting antiqued, imprinted, chemically stained, exposed-aggregate, and colored or uncolored concrete hardscapes and floors: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  1. Scofield. (Basis of Design)
  2. Consolideck LS by Prosoco.
  3. Degussa.
  4. ChemMasters.
  5. Or equal.

### 2.2 PENETRATING WATER REPELLENTS

- A. Patching compound, cementitious, thin patching and skim-coating material, designed for reducing surface defects on interior floors.
  1. Composition and Materials:
    - a. Complex, precisely engineered, polymer-modified, cementitious, thin patching material produced by a proprietary manufacturing and intergrinding process.
    - b. Designed for ease of mixing and installation, superior adhesion without priming, and rapid strength gain, it is a single-component, non-gypsum-based, powdered material containing no sand or calcium chloride.



- B. Product: Cementone by Scofield.
  - 1. Concrete Clear Sealer for protecting antiqued, imprinted, chemically stained, exposed-aggregate, and colored or uncolored concrete hardscapes and floors.
  - 2. Waterborne, modified acrylic emulsion.
  - 3. Optimized for surface penetration, leveling ability, and ease of application by airless sprayer without thinning.
  - 4. Some separation occurs during storage that is easily reincorporated when stirred before using.
  - 5. Cleanup with soap and water.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. New Concrete:
  - 1. Newly placed concrete shall be sufficiently cured to allow concrete to become reactive, minimum 28 days.
  - 2. Do not use liquid curing materials. Cure concrete flatwork with new, unwrinkled, non-staining, high quality curing paper. Do not overlap curing paper.
  - 3. Surfaces shall be cured using the same method and different sections (pours) chemically stained when the concrete is the same age.
  - 4. Immediately prior to chemically staining, thoroughly clean the concrete. Sweep surfaces, the pressure wash or scrub using a rotary floor machine. Use suitable, high-quality commercial detergents to facilitate cleaning. Rinse surfaces after cleaning until rinse water is completely clean. Allow floor to dry completely prior to application of floor stain.
  - 5. Concrete surfaces must be uniformly slip-resistant and profiled to meet a Concrete Surface Preparation (CSP) profile of 1-2 per ICRI guidelines.
  - 6. Some concrete may require abrading to open the surface and make it sufficiently penetrable. In these instances the concrete surface must be sanded using an 60-80 mesh-sanding screen or a grit brush. After sanding, all residue must be removed by power vacuuming. The surface should then be pressure washed or scrubbed using a rotary floor machine.
  - 7. For preparation, the sandblaster should be capable of producing a light, uniform sandblast and be equipped with a dust collector.
  - 8. For preparation, the pressure washer should be equipped with a fan tip and have a minimum pressure capability of 4000 psi. Hot water capability may facilitate cleaning of existing concrete.
  - 9. Acid washing may be required when the above surface preparation does not yield adequate penetration or if there are excessive alkali deposits or surface discoloration. The reacted residue must be abraded using a low-speed floor machine equipped with a 60 mesh screen or a grit brush and then thoroughly rinsed until the rinse water is clear and free of solids, a minimum of two times. After rinsing, neutralize any remaining acid residue by washing with a solution of baking soda (sodium bicarbonate) and water. (Test pH of floor should be 7 or higher.)
- B. Existing Concrete:

1. Clean concrete surfaces so that surfaces are completely penetrable before receiving the initial application of chemical stain. Test surfaces to receive stain by spotting with water. Water should immediately darken the substrate and be readily absorbed. If water beads and does not penetrate or only penetrates in some areas, additional surface preparation and testing shall be performed.
  2. Cleaning method used depends on the condition of the concrete surface. To remove dirt and other contaminants, detergents and other commercial grade cleaners should be considered and tested.
  3. Rinse concrete substrates until rinse water is completely clean.
  4. For preparation of interior floors, the rotary floor machine should be heavy duty and operate at approximately 175 rpm. With a 60-80 mesh-sanding screen or a grit brush, remove all contaminants and weak cement paste from the surface. This will also open the surface to allow the chemical stain to penetrate.
  5. Acid washing may also be required. (Refer to New Concrete Preparation.)
- C. Scoring: Score decorative jointing in concrete surfaces 1/8-inch (3.2 mm) deep with diamond blades. Rinse until water is completely clean.

### 3.2 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.
- C. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

### 3.3 APPLICATION OF SEALER

- A. Concrete substrate shall be completely dry.
- B. Apply sealer according to manufacturer's written instructions at a rate of 300 to 500 square feet per gallon per coat. Two coats are required.
- C. Maintain a wet edge at all times.
- D. Allow sealer to completely dry before applying additional coats.
- E. Apply second coat of sealer at 90 degrees to the direction of the first coat using the same application method and rates.
- F. Seal horizontal joints in areas subject to pedestrian or vehicular traffic.

3.4 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071910

## SECTION 072419 – EXTERIOR INSULATION AND FINISH SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. The Exterior Insulation and Finish Coating Systems Application as described and specified herein.

#### 1.2 DEFINITIONS

- A. Exterior Insulation and Finish System: Exterior assembly comprised of rigid insulation, Adhesives, Base Coat, Reinforcing mesh, and Finish Card.
- B. Class PB Systems: A class of EIFS where the base coat varies in thickness depending upon the number of layers or thickness of Reinforcing Mesh. The reinforcing material is glass fiber mesh, which is embedded into the Base Coat at the time of installation. The Base Coat shall be applied so as to achieve Reinforcing Mesh embedment with no Reinforcing Mesh color visible, nominal 1/16” (1.6 mm). Protective Finish Coats, or various thicknesses, in a variety of textures and colors, are applied over the Base Coat.
- C. Rain screen: A wall cladding design with an exterior surface for primary weather protection and aesthetics, which incorporates an inner secondary Air/Weather Barrier to accommodate incidental moisture and direct it to the exterior.

#### 1.3 SYSTEM DESCRIPTION

A. Design Requirements

1. Polymer-based protective coating 100% pure acrylic resin based materials. No materials using non-acrylic resins in their formulas will be accepted.
2. Exterior insulation and finish system refers to a non-structural exterior wall assembly composed of the following components:
  - An approved substrate.
  - Thermal Insulation board mechanically or adhesively attached to the substrate per manufacturer’s recommendation.
  - A reinforced base coat applied to the insulation board.
  - A 100% acrylic based textured coating applied over the reinforced base coat.
  - Approved sealants are required at all dissimilar materials and are specified in Section 079200.
  - Approved Rainscreen by EIFS manufacturer to accommodate incidental moisture and direct it to the exterior.
3. Impact Resistance:
  - EIMA 101.86 minimum values without cracking:
    1. “Standard” System – Adhesive/ Base Coat – 50-89 in/lb
    2. Hi-Impact/2 System – Adhesive/Base Coat – 90-150 in/lb

Window Rock Office Building and Site  
Construction Documents

4. From grade to 2n floor, a minimum 90-150 inch/pounds impact system is required.
5. From 2<sup>nd</sup> floor up to a minimum 50-89 inch/pounds impact system is required.
6. High traffic areas: provide 150-175 inch/pounds impact system

1.4 SUBMITTALS

- A. Submit "Letter of Conformance".
- B. Product Data: Submit technical product data, test reports, installation instruction and recommendations from manufacturer, including data that materials comply with requirements.
- C. Provide Manufacturer's written certifications of installer.

## 1.5 QUALITY ASSURANCE

- A. Design and Detailing:
1. The System shall be installed in accordance with manufacturer's published details and specific recommendations for this project.
- B. Approvals, Listings, and Classifications:
1. Fire-Test-Response Characteristics: Provide system assemblies and components with the following fire-test-response characteristics as determined by testing identical products per test method indicated below per UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspection agency.
    - Flame Spread of Insulation Board and Finish Coats: 10 or less when tested individually per ASTM E 84.
    - Smoke Developed of Insulation Board and Finish coats: 450 or less when tested individually per ASTM E 84.
  2. Coe Approvals:
    - The EIFS system shall be approved by the applicable building codes and agencies within the jurisdiction of the project. Code approval must be based on full scale diversified fire testing in its end use configuration by independent agencies whose classifications and requirements have general acceptance as regulator.

## 1.6 WARRANTY

- A. Manufacturer shall provide a 10 year limited warranty on the labor and materials associated with the EIFS system. This warranty is exclusive of flashings.
1. This warranty shall be assignable.
  2. This installer shall provide a 2-year warranty for all workmanship related to EIFS application.
- B. Work is warranted against:
1. Material defects, including, but not limited to, peeling, cracking, delamination, flaking or similar failures.
  2. Seepage and leakage of water or excessive moisture into the building or wall cavities through he system. EIFS to EIFS and EIFS to dissimilar sealer joints.
- C. Inspection:
1. The manufacturer shall provide final inspection at the completion of application of the system including all contiguous sealant joints.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

#### A. Manufacturers:

1. “Sto EIFS Next, Sto Essence”; Sto Finish Systems Div.
2. “Syner Flex Systems”; Synergy Div., of Harris Specialty Chemicals, Inc.
3. “Dryvit” Systems, Inc. Outsulation Plus
4. No substitutions permitted

### 2.2 GENERAL:

- #### A. General:
- All components of the wall system shall be obtained from one manufacturer. No substitutions or additions of other materials will be allowed.

### 2.3 MATERIALS:

- #### A. Compatibility:
- Provide substrates, adhesive, board insulation, reinforcing meshes, base and finish coat materials, sealants, an accessories that are compatible with one another and approved for use by system manufacturer for project.

- #### B. Primer/Adhesive:
- A factory blended, polymer modified, cement based adhesive/base coat as recommend by the Manufacturer.

#### C. Vapor Barrier and Tape System:

1. Material: Protecto Flash Building Tape 20, as manufactured by Protecto Warp Co., 225 S. Delaware, Denver, Co., 8023 (303-777-3001) (800-759-9727).
2. Color: Black
3. Width: 6” Minimum.
4. Locations: Provide and install around all opening in EIFS walls. See drawings for details.

- #### D. Trim Accessories:
- Type as designated or require to suit conditions indicated and to comply with system manufacturer’s written requirements, manufactured from vinyl plastic and complying with ASTM C 1063.

1. Casing Beam: Prefabricated on-piece type for attachment behind insulation, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating.
2. Drip Screed: Prefabricated one-piece type for attachment behind insulation, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and extended to form a drip.
3. Control Joints: Zinc alloy; size and profile as recommended by EIFS manufacturer.

- E. Elastomeric Sealant Projects: Provide system manufacturer's listed and recommended chemically curing, elastomeric sealant that is compatible with joint fillers, joints substrates, and other related materials, and complies with requirements for products and testing indicated in "EIMA Guide for Use of Sealants with Exterior Insulation and Finish Systems, Class PB" and with requirements in Section 079200 "Sealants" for products.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with ASTM PS 49 and system manufacturer's written instruction for installation of system as applicable to each type of substrate indicated.
- B. Adhesively and mechanically attach insulation to substrates to comply with ASTM PS 49, system manufacturer's written requirements.
- C. Apply base coat to exposed surfaces of insulation in thickness specified by EIMA and system manufacturer.
- D. Fully embed reinforcing fabric of weight indicated below in wet base coat to produce wrinkle free installation.
- E. Apply finish coat over dry base coat in thickness required by system manufacturer to produce a uniform finish of texture and color matching approved sample.

#### 3.2 INSTALLATION OF JOINT SEALANTS

- A. Prepare joints for sealants, of type and at locations indicated, to comply with applicable requirements and in "EIMA Guide for Use of Sealants with Exterior Insulation and Finish Systems, Class PB."
  - 1. Joint sealants to be applied after base coat has cured but before applying finish coat.

END OF SECTION 072419



## SECTION 075423 – THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Adhered TPO membrane roofing system.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Solar Reflectance Index: Not less than 29 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
- B. Energy Performance: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
  - 1. Submit evidence of compliance with performance requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product.
- B. Source Limitations: Obtain components including roof insulation fasteners for membrane roofing system from same manufacturer as membrane roofing.
- C. 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.

1.7 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. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 TPO MEMBRANE ROOFING

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible fabric backed TPO sheet.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
    - Carlisle SynTec Incorporated
    - Custom Seal Roofing
    - Firestone Building Products Company
    - GAF Materials Corporation
    - GenFlex Roofing Systems
    - Johns Manville
    - Versico Incorporated
  2. Thickness: 60 mils (1.5 mm), nominal.

### 2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
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):
    - Plastic Foam Adhesives: 50 g/L.
    - Gypsum Board and Panel Adhesives: 50 g/L
    - Multipurpose Construction Adhesives: 70 g/L.
    - Fiberglass Adhesives: 80 g/L
    - Single-Ply Roof Membrane Adhesives: 250 g/L.
    - Other Adhesives: 250 g/L.
    - Single-Ply Roof Membrane Sealants: 450 g/L.
    - Non-membrane Roof Sealants: 300 g/L.
    - Sealant Primers for Non-Porous Substrates: 250 g/L.
    - 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. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as sheet membrane.

- C. Bonding Adhesive: Manufacturer's standard.
- D. Slip Sheet: Manufacturer's standard of thickness required for application.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- F. Metal Battens: Manufacturer's standard, aluminum-zinc-allow-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), pre-punched.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

### 2.3 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 728, perlite board, 3/4 inch (19 mm) thick, seal coated.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.
- C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

### 2.4 ROOF INSULATION

- A. Molded-Polystyrene Board Insulation: ASTM C 578, Type II, 1.35 lb/cu. Ft (22 kg/cu. M) minimum density.
- B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.
- C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

### 2.5 INSULATION ACCESSORIES

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.
- C. Cover Board: DOC PS 2, Exposure 1, OSB, 7/16 inch (11 mm) thick.

- D. Protection Mat: Woven or non-woven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

## 2.6 WALKWAYS

- A. Flexible Walkways: Factory-formed, non-porous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer.

## PART 3 - EXECUTION

### 3.1 INSULATION INSTALLATION

- A. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
  - 1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
- B. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.
  - 1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
- C. Install slip sheet over cover board and immediately beneath membrane roofing.

### 3.2 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.
- B. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions require by manufacturer. Stagger end laps.
- C. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
- D. In addition to adhering, mechanically fasten membrane roofing securely at termination, penetrations, and perimeter of roofing.
- E. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- F. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instruction to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

### 3.3 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

### 3.4 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instruction.

### 3.5 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personal to inspect roofing installation on completion.
- B. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

END OF SECTION 075423

## 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 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Sheet metal flashing and trim not specifically specified in other sections.

#### 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.

#### 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.

Window Rock Office Building and Site  
Construction Documents

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.

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.
- 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.

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 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sheet metal flashing and trim that fails in materials or workmanship within specified warranty period.
  1. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  2. Warranty Period: 2 years.
- B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Galvanized Sheet Metal Flashing and Trim:
  1. Fry Reglet Corporation.



Window Rock Office Building and Site  
Construction Documents

2. Hickman, W. P. Company.
3. Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
4. Or equal.

## 2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. 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.
  1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, G90 coating designation; structural quality.
  2. 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.
  3. Color: As selected by Architect from manufacturer's full range.
  4. 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.

## 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 manufacturer of primary sheet metal or manufactured item 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 or manufactured item.
  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.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153 or ASTM F 2329 or Series 300 stainless steel.
- C. Solder:
  1. 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.

- 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 polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

## 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 tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- 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. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

## 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. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 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. 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 sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws and metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance .
- 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 Division 7 Section "Joint Sealants."

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 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.

G. Flashing corners shall be shop fabricated and fully soldered such that corner assemblies are single monolithic units for 18" in all directions from corners.

### 3.3 MISCELLANEOUS FLASHING INSTALLATION

A. Overhead-Piping Safety Pans: Suspend pans independent from structure above as indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

B. 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.

### 3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

### 3.5 CLEANING AND PROTECTION

A. Clean and neutralize flux materials. Clean off excess solder.

B. Clean off excess sealants.

C. 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.

D. 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 076500 - FLEXIBLE SHEET FLASHING

### 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 the following:
  - 1. Flexible sheet flashing for windows, doors, parapets, and other openings and where indicated on Drawings.

#### 1.3 SUBMITTALS

- A. Concurrent Review Requirements: Submit submittals of this section with doors and windows sections.
- B. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of flexible sheet flashing.
- C. Shop Drawings: Show locations and extent of flexible sheet flashing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- D. Samples: For the following products:
  - 1. 12-by-12-inch square of flexible sheet flashing.
- E. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- F. Qualification Data: For Installer.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for flexible sheet flashing.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is acceptable to flexible sheet flashing manufacturer for installation of flexible sheet flashing required for this Project.

- B. Source Limitations: Obtain flexible sheet flashing materials through one source from a single manufacturer.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup with doors and windows.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to flexible sheet flashing including, but not limited to, the following:
  - 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 and discuss the flashing to be coordinated with the finishing of doors and windows.
  - 3. Review, discuss, and coordinate the interrelationship of flexible flashing with other exterior wall components. Include provisions for sealants and fasteners.
  - 4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
  - 5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

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

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of flexible sheet flashing that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 2 years.
- B. Installer's Warranty: 1 year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Flexible Sheet Flashing: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
1. WR Grace (Basis of Design).
  2. FortiFlash by Fortifiber.
  3. FlexWrap and StraightFlash by DuPont.
  4. Or equal.

### 2.2 FLEXIBLE SHEET FLASHING

- A. Product: Vycor Plus by WR Grace or equal.
1. Self-Adhered, cross-laminated high-density polyethylene (HDPE) sheet, backed by aggressive pressure-sensitive rubberized asphalt adhesive.
  2. Thickness: 25 mil minimum per ASTM D3767, Method A.
  3. Low temperature flexibility: Unaffected at minus 45 degrees F. per ASTM D1970.
  4. Elongation, ultimate failure of rubberized asphalt: 200 percent minimum per ASTM D412.
  5. Cracked cycling 100 cycles: Unaffected at minus 25 degrees F. per ASTM C836.
  6. Lap adhesion at minimum application temperature: 60 plf width per ASTM D1876 modified.
  7. Adhesion to concrete at minimum application temperature: 60 plf width per ASTM D903.
  8. ICBO: ER-6141.
  9. Recommended exposure limit: 30 days.
  10. Perm-A-Barrier by Grace is not acceptable.

### 2.3 AUXILIARY MATERIALS

- A. Mastic, Joint Sealant, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by flexible sheet flashing manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
1. Verify that concrete has cured and aged for minimum time period recommended by flexible sheet flashing manufacturer.
  2. Proceed with installation only after unsatisfactory conditions have been corrected.

Window Rock Office Building and Site  
Construction Documents

3.2 INSTALLATION

- A. Install flexible sheet flashing in accordance with the manufacturer's written instructions, AAMA Publication 2400, and the applicable code.

END OF SECTION 076500



## SECTION 077200 - ROOF ACCESSORIES

### 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 the following:
  - 1. Roof accessories.
- B. Related Sections include the following:
  - 1. Division 7 Section "Sheet Metal Flashing and Trim" for shop- and field-fabricated metal flashing and counterflashing, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
  - 2. Division 9 Section "Painting" for field finishes.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.
- C. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
  - 1. Size and location of roof accessories specified in this Section.
  - 2. Method of attaching roof accessories to roof or building structure.
  - 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
- D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
  - 1. With Architect's approval, adjust location of roof accessories that would interrupt roof drainage routes.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of roof accessories that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: 2 years.
- B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Roof Curbs: Subject to compliance with requirements, provide products by one of the following manufacturers.
  - 1. Custom Curb, Inc.
  - 2. LM Curbs.

## Window Rock Office Building and Site

### Construction Documents

3. ThyCurb; Div. of Thybar Corporation.
4. Or equal.

## 2.2 METAL MATERIALS

- A. Galvanized Steel Sheet: ASTM A 653, G90 coated and mill phosphatized for field painting.
  1. Comply with Division 9 Section "Painting" for field finishes.
- B. Galvanized Steel Tube: ASTM A 500, round tube, hot-dip galvanized to comply with ASTM A 123.
- C. Galvanized Steel Pipe: ASTM A 53.

## 2.3 MISCELLANEOUS MATERIALS

- A. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWWA C2; not less than 1-1/2 inches thick.
- B. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.
- C. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
- D. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.
- F. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

## 2.4 ROOF CURBS

- A. Roof Curbs: Provide metal roof curbs, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Fabricate with welded or sealed mechanical corner joints, with integral metal cant and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
  1. Material: Galvanized steel sheet, 0.079 inch thick.
    - a. Finish: Factory prime painted and field painted per Division 9 Section "Painting".
  2. Factory insulate curbs with 1-1/2-inch- thick, cellulosic or glass-fiber board insulation.
  3. Curb height may be determined by adding thickness of roof insulation and minimum base flashing height recommended by roofing membrane manufacturer. Fabricate units to minimum height of 12 inches, unless otherwise indicated.
  4. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water

diverter or cricket and with height tapered to match slope to level tops of units.

## 2.5 FINISH

- A. Galvanized Steel: Field finish per Division 9 Section "Painting".

## 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 work.
  1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
  2. Verify dimensions of roof openings for roof accessories.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Install roof accessories to fit substrates and to result in watertight performance.
- C. 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 manufacturer.
  1. Coat concealed side of roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
  3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.
- D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
- E. Roof Curb Installation:
  1. Set roof curb so top surface of roof curb is level.
- F. Preformed Flashing Installation:
  1. Secure to roof membrane according to vent and stack flashing manufacturer's written instructions.
- G. Seal joints with elastomeric sealant as required by manufacturer of roof accessories.

3.3 TOUCH UP

- A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Division 9 painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.4 CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION 077200

BILCO Type E-50TB thermally broken roof hatches, 36" x 36" (914mm x 914mm) provide roof top access by means of a fixed interior ladder. Roof hatches feature a frame and cover design that minimizes heat transfer between interior and exterior metal surfaces. The result is a product that resists harmful condensation and provides superior energy efficiency. The easy, one-hand operation, to the fully open or closed position, provides the user the security of having one hand firmly on the ladder at all times. Roof hatches are available in aluminum construction. For more information, please visit our website [www.bilco.com](http://www.bilco.com) or call 1-800-366-6530.

## SECTION 077233

### ROOF HATCHES

#### (BILCO TYPE E-50TB)

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Work Included: Provide factory-fabricated roof hatches for ladder access.

##### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data.
- B. Shop Drawings: Submit shop drawings including profiles, accessories, location, adjacent construction interface, and dimensions.
- C. Warranty: Submit executed copy of manufacturer's standard warranty.

##### 1.3 QUALITY ASSURANCE

- A. Manufacturer: A minimum of 5 years experience manufacturing similar products.
- B. Installer: A minimum of 2 years experience installing similar products.
- C. Manufacturer's Quality System: Registered to ISO 9001:2008 Quality Standards including in-house engineering for product design activities.

##### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-ventilated area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

##### 1.5 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

- A. Basis-of-Design Manufacturer: Type E-50TB Roof Hatch by The BILCO Company, P.O. Box 1203, New Haven, CT 06505, 1-800-366-6530, Fax: 1-203-933-8478, Web: www.bilco.com.

### 2.2 ROOF HATCH

- A. Furnish and install where indicated on plans metal roof hatch Type E-50TB, size width: 36" (914mm) x length: 36" (914mm). Length denotes hinge side. The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer.
- B. Performance characteristics:
1. Cover and curb shall be thermally broken to prevent heat transfer between interior and exterior surfaces.
  2. Cover shall be reinforced to support a minimum live load of 40 psf (195kg/m<sup>2</sup>) with a maximum deflection of 1/150th of the span or 20 psf (97kg/m<sup>2</sup>) wind uplift.
  3. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
  4. Operation of the cover shall not be affected by temperature.
  5. Entire hatch shall be weather tight with fully welded corner joints on cover and curb.
- C. Cover: Shall be 11 gauge (2.3mm) aluminum with a 5" (127mm) beaded flange with formed reinforcing members. Interior and exterior surfaces shall be thermally broken to minimize heat transfer and to resist condensation. Cover shall have a heavy extruded EPDM rubber gasket bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
- D. Cover insulation: Shall be 3" (75mm) thick polyisocyanurate with an R-value = 18 (U=0.315 W/m<sup>2</sup>K), fully covered and protected by an 18 gauge (1mm) aluminum liner.
- E. Curb: Shall be 12" (305mm) in height and of 11 gauge (2.3mm) aluminum. Interior and exterior surfaces shall be thermally broken to minimize heat transfer and to resist condensation. The curb shall be formed with a 5-1/2" (140mm) flange with 7/16" (11mm) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip<sup>®</sup> flashing system, including stamped tabs, 6" (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.
- F. Curb insulation: Shall be 3" (75mm) thick polyisocyanurate with an R-value = 18 (U=0.315 W/m<sup>2</sup>K).
- G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.
- H. Hardware
1. Heavy stainless steel pintle hinges shall be provided
  2. Cover shall be equipped with a spring latch with interior and exterior turn handles
  3. Roof hatch shall be equipped with interior and exterior padlock hasps.

4. The latch strike shall be a stamped component bolted to the curb assembly.
  5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle to permit easy release for closing.
  6. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed. [For installation in highly corrosive environments or when prolonged exposure to hot water or steam is anticipated, specify Type 316 stainless steel hardware].
  7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.
- I. Finishes: Factory finish shall be mill finish aluminum.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.
1. Test units for proper function and adjust until proper operation is achieved.
  2. Repair finishes damaged during installation.
  3. Restore finishes so no evidence remains of corrective work.

#### 3.3 ADJUSTING AND CLEANING

- A. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

END OF SECTION



## SECTION 079200 - JOINT SEALANTS

### 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 joint sealants.
- B. Related Sections include the following:
  - 1. Division 9 Section "Gypsum Board" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

#### 1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- D. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- E. Qualification Data: For Installer.
- F. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

- G. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.
- H. Warranties: Special warranties specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

#### 1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

#### 1.7 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 2 years.
- B. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
  - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
  - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.
- C. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 2 years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Joint Sealants: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  - 1. Sika Corporation
  - 2. Pecora Corporation.
  - 3. Bostik.
  - 4. Dow Corning Corp.
  - 5. GE Plastics.
  - 6. Sonneborn Building Products, ChemRex, Inc.
  - 7. Tremco, Inc.
  - 8. Or equal.

### 2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants:
  - 1. As selected by Architect from manufacturer's full range.
  - 2. Areas where concrete joint sealant will be adjacent to concrete other than standard gray, sealant color shall match adjacent color as approved by Architect.

### 2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
  - 3. Remove laitance and form-release agents from concrete.
    - a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

- E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
  - 4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
  - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- H. Installation of Preformed Tapes: Install according to manufacturer's written instructions.
- I. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
  - 1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
  - 2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
  - 3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
  - 4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- J. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

### 3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.6 JOINT-SEALANT LOCATION

- A. General Purpose Exterior Sealant: Polyurethane; ASTM C 920, Grade NS, Class 25, Uses M, G, and A; single component.
  - 1. Products:
    - a. SikaFlex 1A or 15LM by Sika Corp
    - b. Dynatrol I-XL by Pecora.
  - 2. Color: Standard colors matching finished surfaces.
  - 3. Applications:
    - a. Control, expansion, and soft joints in masonry.
    - b. Joints between concrete and other materials.
    - c. Joints between metal frames and other materials.
    - d. Other exterior joints for which no other sealant is indicated.
- B. Exterior Metal Lap Joint Sealant: Silicone, Butyl or polyisobutylene, nondrying, nonskinning, noncuring.
  - 1. Products:
    - a. SikaSil WS-795 Silicone by Sika Corp.
    - b. 895 Silicone or Sil-Span by Pecora.
  - 2. Color: Standard colors matching finished surfaces.
  - 3. Applications:
    - a. Concealed sealant bead in sheet metal work.
    - b. Concealed sealant bead in siding overlaps.
- C. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C 834, Type OP, Grade NF single component, paintable.
  - 1. Products:
    - a. AC-20 manufactured by Pecora.
  - 2. Color: Standard colors matching finished surfaces.
  - 3. Applications:
    - a. Interior wall and ceiling control joints.
    - b. Joints between door and window frames and wall surfaces.
    - c. Other interior joints for which no other type of sealant is indicated.
- D. Tile Sealant: Silicone; ASTM C 920, Uses I, M and A; single component, mildew resistant.
  - 1. Products:
    - a. SikaSil GP or N+ Silicone Sealant by Sika Corp.
    - b. 898 Silicone Sanitary Sealant by Pecora.
  - 2. Color: Match adjacent color.
  - 3. Applications:

Window Rock Office Building and Site  
Construction Documents

- a. Joints between plumbing fixtures and floor and wall surfaces.
  - b. Joints between restroom countertops and wall surfaces.
- E. Interior Floor Joint Sealant: Polyurethane, chemically-curing, cold-applied, self-leveling elastomeric sealant; ASTM C 920, Grade P, Class 25, Uses T, M and A; two-part.
1. Products:
    - a. SikaFlex 2C SL or NS with TG Additive by Sika Corp.
    - b. NR-200 self-leveling polyurethane and/or DYNATRED non-sag, traffic-grade polyurethane sealants by Pecora.
  2. Primer: SikaFlex 429 Primer; P-150, P-75 or P-200.
  3. Color: Standard colors matching finished surfaces.
  4. Applications: Use for joints up to 1-1/2 inches.
    - a. Expansion joints in floors.
- F. Concrete Paving Joint Sealant: Polyurethane, chemically-curing, cold-applied, self-leveling elastomeric sealant; ASTM C 920, Class 25, Uses T, I, M and A; two-part.
1. Products:
    - a. NR-200 Urexpand and/or DYNATRED non-sag, traffic-grade polyurethane sealant by Pecora or equal.
  2. Primer: SikaFlex 429 Primer; P-150, P-75 or P-200.
  3. Color: Gray.
  4. Applications:
    - a. Joints in sidewalks and vehicular paving.
- G. Sanitary Sealants: Provide ASTM C920, Type S, Grade NS, Class 25, Use NT. When fully cured and washed, sealant shall meet the requirements of the Food and Drug Administration Regulation 21 CFR 177.2600 for use in areas where sealant comes in contact with food.
1. Color: As selected by Architect from manufacturer's full range.
  2. Backer Rod shall be closed-cell polyethylene rod stock, larger than joint width.
- H. Butyl Sealant: ASTM C 920, Grade NS, Class 12-1/2, Uses NT, M, A, G, O; single component, solvent release, non-skinning, non-sagging.
1. Products:
    - a. BC-158 sealant by Pecora.
  2. Color: Standard colors matching finished surfaces.
  3. Movement Capability: Plus and minus 12-1/2 percent.
  4. Service Temperature Range: -13 to 180 degrees F.
  5. Shore A Hardness Range: 10 to 30.
- I. Silicone Sealant: ASTM C 920, Grade NS, Class 25, Uses NT, A, G, M, O; single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding.
1. Products:
    - a. SikaSil WS 290 or WS 295 by Sika Corp.
    - b. 864 LM Architectural silicone or 890 silicone sealant by Pecora.
    - c. 790 by Dow Corning Corporation.
  2. Color: Standard colors matching finished surfaces.
  3. Movement Capability: Plus and minus 25 percent.
  4. Applications:
    - a. Interior or exterior for joints 1/8 to 1-1/2 inch wide.
    - b. Exterior use at expansion joints in masonry where substantial movement is

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- c.      expected.  
          Glazing application.

END OF SECTION 079200



## SECTION 081113 - STEEL DOORS AND FRAMES

### 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. Section Includes:
  - 1. Standard hollow metal doors and frames.
- B. Related Sections include the following:
  - 1. Division 7 Section "Flexible Sheet Flashing" for flashing windows, door, and other penings.
  - 2. Division 8 Section "Flush Wood Doors" for wood door with steel frames.
  - 3. Division 8 Section "Door Hardware" for door hardware for hollow metal doors.
  - 4. Division 8 Section "Glazing" for glazing requirements.
  - 5. Division 9 Section "Painting" for field painting hollow metal doors and frames.

#### 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, and finishes.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  - 1. Provide additional protection to prevent damage to finish of factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.
  - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## 1.8 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of steel doors and frames that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: 2 years.
- B. Installer's Warranty: 1 year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Steel Doors and Frames: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  - 1. Steelcraft; an Ingersoll-Rand company. (Basis of Design).
  - 2. Ceco Door Products; an Assa Abloy Group company.
  - 3. Curries Company; an Assa Abloy Group company.

4. Or equal.

## 2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications for interior doors and frames.
- B. Galvannealed (Metallic-Coated) Steel Sheet: ASTM A 653, Commercial Steel (CS), Type B; with minimum A60 metallic coating for exterior doors and frames.
- C. Frame Anchors: ASTM A 591, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
  1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153.
- E. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143.
- G. Glazing: Comply with requirements in Division 8 Section "Glazing."
  1. Tempered where required.
- H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
  1. Design: Flush panel.
  2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
    - a. Standard Core: Honeycomb, U-factor of 0.69, R-value of 1.45.
  3. Vertical Edges for Single-Acting Doors: Beveled edge.
    - a. Beveled Edge: 1/8 inch in 2 inches.
  4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
  5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick, end closures or channels of same material as face sheets.
  6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

7. Vision, Narrow Lite, Half Glass Doors: Size as indicated on Drawings.
- B. Exterior Doors: Face sheets fabricated from galvanized (metallic-coated) steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SKI A250.8 for level and model and ANSI/SKI A250.4 for physical performance level:
  1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush):
    - a. Face thickness: 16 gage (0.053 inch).
      - 1) Product: Series L16 by Steelcraft.
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless galvanized (metallic-coated) sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SKI A250.8 for level and model and ANSI/SKI A250.4 for physical performance level:
  1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush):
    - a. Face thickness: 18 gage (0.042 inch).
      - 1) Product: Series L18 by Steelcraft.
- D. Hardware Reinforcement: Fabricate according to ANSI/SKI A250.6 with reinforcing plates from same material as door face sheets.

#### 2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SKI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
  1. Fabricate frames with mitered or coped corners.
  2. Fabricate frames as full profile welded unless otherwise indicated.
  3. Frame: 16 gage (0.053-inch) thick steel sheet.
    - a. Product: F16 Series by Steelcraft.
- C. Interior Frames: Fabricated from cold-rolled steel sheet.
  1. Fabricate frames with mitered or coped corners.
  2. Fabricate frames as full profile welded. Knocked down is not allowed.
  3. Frame: 16 gage (0.053-inch) thick steel sheet.
    - a. Product: F16 Series by Steelcraft.
  4. Frames for Wood Doors: Same type as for steel doors.
  5. Frames for Borrowed Lights: Same as adjacent door frame.
- D. Hardware Reinforcement: Fabricate according to ANSI/SKI A250.6 with reinforcement plates from same material as frames.

#### 2.5 FRAME ANCHORS

- A. Jamb Anchors:
  1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
  - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
  - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

## 2.6 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

## 2.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- wide steel.
- C. Provide Screw-In Top Cap for exterior doors.

## 2.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances:
  - 1. Standard doors and frames: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
  - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
  - 2. Glazed Lites: Factory cut openings in doors.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
  2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  6. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Three anchors per jamb up to 60 inches high.
      - 2) Four anchors per jamb from 60 to 90 inches high.
      - 3) Five anchors per jamb from 90 to 96 inches high.
      - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      - 5) Two anchors per head for frames above 42 inches wide and mounted in stud partitions.
    - b. Compression Type: Not less than two anchors in each jamb.
  7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
  3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
  2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  4. Provide loose stops and moldings on inside of hollow metal work.

5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

- H. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2/NAFS, Air Infiltration Test.
  1. Maximum Rate: 0.3 cfm/sq. ft. of area at an inward test pressure of 1.57 lbf/sq. ft.
  2. Maximum Rate: 0.1 cfm/sq. ft. of area at an inward test pressure of 6.24 lbf/sq. ft.

## 2.9 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
  1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- B. Field-Applied Paint Finish: Comply with Division 9 Section "Painting".

## 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.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
  1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - b. Install frames with removable glazing stops located on secure side of opening.
    - c. Install door silencers in frames before grouting.
    - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - f. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
  2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
    - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  3. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
  5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on



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

### 3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

## SECTION 081416 - FLUSH WOOD DOORS

### 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 solid-core doors.
- B. Related Sections include the following:
  - 1. Division 8 Section "Glazing" for glass view panels in flush wood doors.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- B. Other Action Submittals:
  - 1. Schedule: Provide a schedule of flush wood door work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.
    - a. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
    - b. Indicated specific model number of door and frame.
    - c. Indicated hardware group.
    - d. Indicate dimensions and locations of mortises and holes for hardware.
    - e. Indicate dimensions and locations of cutouts.
    - f. Indicate requirements for veneer matching.
    - g. Indicate doors to be factory finished and finish requirements.
- C. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:
  - 1. Faces of Factory-Finished Doors: Show the full range of colors available for stained finishes.
- D. Samples for Verification:
  - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edgings representing typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors.
3. Frames for light openings, 6 inches long, for each material, type, and finish required.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.
- B. Quality Standard: Comply with NWWDA I.S.1-A, "Architectural Wood Flush Doors."
  1. Performance duty Level: Extra Heavy Duty.
  2. Factory machined for door hardware and high density hardware blocking.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch top to bottom, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
  1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
  2. Warranty:
    - a. Solid-Core Interior Doors: Life of installation.
- B. Installer's Warranty: 1 year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Flush Wood Doors: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  - 1. Signature Series by Marshfield Door Systems. (Basis of Design)
  - 2. Algoma Hardwoods Inc.
  - 3. Eggers Industries; Architectural Door Division.
  - 4. Maiman Company.
  - 5. Marlite.
  - 6. VT Industries Inc.
  - 7. Haley Brothers, Inc.
  - 8. Or equal.

### 2.2 DOOR CONSTRUCTION, GENERAL

- A. Adhesives: Do not use adhesives containing urea formaldehyde.
- B. Doors for Transparent Finish:
  - 1. Grade: Custom (Grade A faces).
  - 2. Species and Cut: White birch, plain sliced.
  - 3. Match between Veneer Leaves: Book match.
  - 4. Assembly of Veneer Leaves on Door Faces: Running match.
  - 5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

### 2.3 SOLID-CORE DOORS

- A. Core:
  - 1. Stave Lumber Core: May be a combination of solid, low-density hardwood lumber blocks or strips not more than 2-1/2" wide of one species of wood between 6% to 9% moisture content. Joints to be tight and staggered in adjacent rows. Lumber density is 25 to 27 lbs. per cubic foot.
- B. Veneer-Faced Doors:
  - 1. Construction: Five or seven plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

### 2.4 DOOR FRAMES

- A. Hollow Metal Frames: Comply with Division 8 Section "Steel Door and Frames".

## 2.5 FABRICATION

- A. Fabricate doors in sizes indicated for Project-site fitting.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
  - 1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
  - 1. Light Openings: Trim openings with moldings of material and profile indicated.

## 2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing.
- B. Finish doors at factory.
- C. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
- D. Finish doors at factory where indicated in schedules or on Drawings as factory finished.
- E. Transparent Finish:
  - 1. Grade: Custom.
  - 2. Finish: NWWDA I.S.1-A System TR-6 catalyzed polyurethane.
  - 3. Staining: As selected by Architect from manufacturer's full range.
  - 4. Sheen: Semigloss.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
  - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."

- B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
  - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold.
  - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### 3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 16

## SECTION 087100 - DOOR HARDWARE

### 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. Commercial door hardware for the following:
    - a. Swinging doors.
    - b. Fire-rated swinging doors.
    - c. Other doors to the extent indicated.

#### 1.3 SUBMITTALS

- A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Details of electrified door hardware, indicating the following:
- C. Samples for Verification: For exposed door hardware of each type, in specified finish, full size. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of the final door hardware sets, if requested.
  - 1. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
- D. Qualification Data: For Installer.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for locks, latches, and closers as requested.
- F. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.
- G. Warranty: Special warranty specified in this Section.
- H. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and

diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
  2. Content: Include the following information:
    - a. Identification number, location, hand, fire rating, and material of each door and frame.
    - b. Type, style, function, size, quantity, and finish of each door hardware item.
    - c. Complete designations of every item required for each door or opening including name and manufacturer.
    - d. Fastenings and other pertinent information.
    - e. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - f. Explanation of abbreviations, symbols, and codes contained in schedule.
    - g. Mounting locations for door hardware.
    - h. Door and frame sizes and materials.
    - i. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
      - 1) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.
    - j. List of related door devices specified in other Sections for each door and frame.
  3. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.
- I. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

#### 1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
2. Installer shall have warehousing facilities in Project's vicinity.
3. Scheduling Responsibility: Preparation of door hardware and keying schedules.



4. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
  - B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
  - C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
    1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
  - D. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." In addition to Owner, Construction Manager, Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant and Owner's Security Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
    1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
    2. Preliminary key system schematic diagram.
    3. Requirements for key control system.
    4. Address for delivery of keys.
  - E. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
  - B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.
  - C. Deliver keys to Owner's Representative by registered mail or overnight package service.

## 1.6 COORDINATION

- A. Coordinate layout and installation of recessed hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Coordinate with aluminum entrance door supplier for door hardware installation.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including excessive deflection, cracking, or breakage.
    - b. Faulty operation of operators and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Three (3) years from date of Substantial Completion, except as follows:
    - a. Electromagnetic Locks: Five (5) years from date of Substantial Completion.
    - b. Exit Devices: Two (2) years from date of Substantial Completion.
    - c. Manual Closers: Ten (10) years from date of Substantial Completion.

## 1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide six (6) months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Products:
    - a. Finish: To Match Existing.
    - b. Manufacture Standard:
      - 1) Butts: Schlage or Approved by Owner
      - 2) Locksets: Schlage or Approved by Owner
      - 3) Closers: Schlage or Approved by Owner
      - 4) Exit Devices: Schlage or Approved by Owner
      - 5) Trim: Schlage or Approved by Owner
      - 6) Weatherstrip: Schlage or Approved by Owner
      - 7) Continuous Hinges: Schlage or Approved by Owner
- B. Substitution requests will be made in accordance with Division 01 requirements.

### 2.2 SCHEDULED HARDWARE

- A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:
1. Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified under the Article "Manufacturers" in Part 2 for each hardware type, the comparable product of one of the other manufacturers that complies with requirements.
  2. ANSI/BHMA designations used elsewhere in this Section or in schedules to describe hardware items or to define quality or function are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this Section.
    - a. Butts and Hinges: ANSI A156.1.
    - b. Bored and Preassembled Locks and Latches: ANSI/BHMA A156.2.
    - c. Exit Devices: ANSI A156.3.
    - d. Door Controls - Closers: ANSI A156.4. 180 degree swing only!
    - e. Auxiliary Locks and Associated Products: ANSI/BHMA A156.5.
    - f. Architectural Door Trim: ANSI A156.6.
    - g. Template Hinge Dimensions: ANSI A156.7.
    - h. Door Controls - Overhead Holders: ANSI A156.8.

- i. Mortise Locks and Latches: ANSI A156.13.
- j. Closer Holder Release Devices: ANSI A156.15.
- k. Auxiliary Hardware: ANSI A156.16.
- l. Self-Closing Hinges and Pivots: ANSI A156.17.
- m. Materials and Finishes: ANSI A156.18.

## 2.3 MATERIALS AND FABRICATION

- A. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.
- B. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
- C. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
- D. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

## 2.4 HINGES, GENERAL

- A. Quantity: Provide the following, unless otherwise indicated:
  - 1. Two Hinges: For doors with heights up to 60 inches.
  - 2. Three Hinges: For doors with heights 61 to 90 inches.
- B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- C. Hinge Weight: As indicated in hardware sets.
- D. Hinge Base Metal: Unless otherwise indicated, provide the following:
  - 1. Exterior Hinges: Stainless steel with stainless-steel pin.
  - 2. Interior Hinges: Steel with steel pin.
  - 3. Hinges for Fire-Rated Assemblies: Steel with steel pin.

- E. Hinge Options: Where indicated in door hardware sets or on Drawings:
  - 1. Safety Stud: Designed for stud in one leaf to engage hole in opposing leaf.
  - 2. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging doors.
  - 3. Corners: Square.
- F. Fasteners: Comply with the following:
  - 1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
  - 2. Wood Screws: For wood doors and frames.
  - 3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.

## 2.5 CONTINUOUS HINGES

- A. Hinges shall be a geared continuous hinge utilizing a single gear section for the door leaf and a separate gear section for the frame side of the door. The door leaf and jamb leaf shall fully mortised where scheduled, and full surface where scheduled. Geared hinges are to be certified to ANSI 156.25, Grade 2 and UL 10C tested and approved for 90 minutes.

## 2.6 LOCKS, LATCHES, AND BOLTS

- A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.
- B. Lock Throw: Provide 5/8-inch (16-mm) minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
- C. Flush Bolt Heads: Minimum of 1/2-inch- (13-mm-) diameter rods of brass, bronze, or stainless steel with minimum 12-inch- (300-mm-) long rod for doors up to 84 inches (2100 mm) in height. Provide longer rods as necessary for doors exceeding 84 inches (2100 mm) in height.
- D. Cylindrical Locks - ANSI A156.2 Series 4000, Grade 1 Strength and Operational requirements. Meets A117.1 Accessibility Codes. Latch bolts shall be steel with minimum 1/2" throw, deadlocking on keyed and exterior functions. 3/4" throw anti-friction latchbolt on pairs of fire doors. Lock case shall be steel. Lock shall incorporate one piece spring cage and spindle. Provide 5/8" minimum throw of latch and deadbolt used on pairs of doors.

## 2.7 KEYING REQUIREMENTS

- A. General: Supplier will meet with Owner to finalize keying requirements and obtain final instructions in writing.
- B. Review the keying system with the Owner and provide the type required (master, grandmaster or great-grandmaster), either new or integrated with Owner's existing system. If key pinning charts are required, owner to furnish charts to hardware supplier.

- C. Furnish temporary keyed cores for the construction period, and remove these when directed. The construction cores remain property of the supplier and shall be returned to the supplier when they are removed. Contractor shall install the permanent cores in the presence of the owner's representative.
- D. Permanent Keys: Secured shipment direct from point of origination to Owner's Representative
  - 1. For estimate: 2 keys per change combination, 5 master keys per group, 5 grand-master keys, 3 control keys.

## 2.8 PUSH/PULL UNITS

- A. Exposed Fasteners: Provide manufacturer's standard exposed fasteners for installation, thru-bolted.

## 2.9 CLOSERS

- A. Accessibility Requirements: Where handles, pulls, latches, locks and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural Transportations Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
  - 1. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-fire-rated Hinged Doors: 5 lbf applied perpendicular to door.
    - b. Fire Doors: Minimum opening force allowable by Authorities Having Jurisdiction (AHJ).
- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15lbf to open door to minimum required width.
- C. All door exterior closers shall be tested to ANSI/BHMA A156.4 test requirements. Cylinder shall have been manufactured and in the marketplace for a minimum of 10 years
- D. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory sized closers, adjustable to meet field conditions and requirements for opening force.
- E. Surface Closers: BHMA A156.4 Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.
  - 1. Full rack-and-pinion type cylinder with removable non-ferrous cover.
  - 2. ISO 2000 certified. Units stamped with date-of-manufacture code.
  - 3. Thru-bolts at wood doors unless doors are provided with closer blocking. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.
  - 4. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.

5. Opening pressure: Exterior doors 8.5 lb., interior doors 5 lb., labeled fire doors 15 lb.
6. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
7. Heavy-duty arms at exterior doors scheduled with parallel arm units.
8. Exterior doors do not require seasonal adjustments in temperatures from 120 degrees F to -30 degrees F, furnish data on request.
9. Non-flaming fluid will not fuel door or floor covering fires.

## 2.10 EXIT DEVICES/PANIC HARDWARE

- A. General features: BHMA A156.3, Grade 1.
- B. Accessibility Requirements: Where handles, pulls, latches, locks and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural Transportations Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
  1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
- C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15lbf to release the latch. Locks shall not require use of a key, tool of special knowledge for operation.
- D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to AHJ for panic protection, based on testing according to UL 305.
  1. Push-through touch pad design. No exposed touch bar fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.
  2. No exposed screws to show through glass doors.
  3. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.
- E. Specific features:
  1. Non-Fire Rated Devices: As scheduled in hardware sets.
  2. Lever Trim: Vandal resistant, forged brass or bronze escutcheon min .130" thickness, match lockset lever design.
  3. Fire-Labeled Devices: UL label indicating "Fire Exit Hardware". Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.
  4. Electrically Operated Devices: Single manufacturer source for electric latch retraction devices, electrically controlled trim, power transfers, power supplies, monitoring switches and controls.
  5. Provide all shim kits and filler plates to allow flush mounting of exit devices on all types of doors used in this project.
  6. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key.

2.11 TRIM AND STOPS

- A. Kick plates, mop plates, and armor plates, shall be .050 gauge with 32D finish. Kick plates to be 10" high, mop plates to be 5" high. All plates shall be two (2) inches less full width of door.
- B. Push plates, pull plates, door pulls, and miscellaneous door trim shall be shown in the hardware schedule.
- C. Doorstops shall be furnished for all doors to prevent damage to doors or hardware from striking adjacent walls or fixtures. Wall stops are preferred. Floor stops are used only where noted in hardware schedule. Where conditions prohibit the use wall type stops, furnish overhead stops either surface mounted or concealed as noted in hardware sets.

2.12 WEATHERSTRIPPING AND SEALS

- A. General: Provide continuous weatherstripping on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.13 THRESHOLDS

- A. General: Except as otherwise indicated, provide standard metal threshold unit of type, size, and profile as shown or scheduled.

2.14 HARDWARE FINISHES

- A. Match items to the manufacturer's standard color and texture finish for the latch and locksets (or push-pull units if no latch or lock sets).
- B. Provide finishes that match those established by BHMA or, if none established, match the Architect's sample.
- C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- D. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.



### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
  - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.
- B. Wood Doors: Comply with DHI A115-W Series.

#### 3.3 INSTALLATION

- A. Pre-installation conference shall be conducted prior to installation of hardware at Project site. Meet with the, Owner, Contractor, installer, and manufacturer's representatives. A separate pre-installation conference shall be conducted prior to the installation of electronic security hardware with the electrical contractor Review catalogs, brochures, templates, installation instructions, and the approved hardware schedule. Survey installation procedures and workmanship, with special emphasis on unusual conditions, as to ensure correct technique of installation, and coordination with other work. Notify participants at least ten, 10 working days before conference.
- B. Hardware Installers must have a minimum of five (5) years of experience in installation of hardware. Provide verification of installer's qualification to Consultant for approval. All installers to attend review meetings with the hardware distributor.
- C. Install hardware using only manufacturer supplied and approved fasteners in strict adherence with manufacturers published installation instructions.
- D. Install head seal prior to installation of "PA"-parallel arm mounted door closers and push side mounted door stops/holders. Trim, cut and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Install thresholds and saddles in a bed of caulking completely sealing the underside from water and air penetration.
- E. Counter sink through bolt of door pull under push plate during installation.
- F. Mounting Heights: Mount door hardware units at heights indicated, as follows, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- G. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- H. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

### 3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
  2. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

### 3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 (NOT USED)

3.7 DOOR HARDWARE SETS

- A. Refer to architectural drawings and owner for hardware schedule. Supplier is to refer to general conditions, special conditions, and the full requirements of this section. It shall be the hardware supplier's responsibility to furnish all required hardware.
- B. Where items of hardware are not definitely or correctly specified and are required for completion of the Work, a written statement of such omission, error, conflict, or other discrepancy shall be sent to the Architect, prior to date specified for receipt of bids, for clarification by addendum.
- C. Adjustments to the Contract Sum will not be allowed for omissions or items of hardware not clarified prior to bid opening.

END OF SECTION 087100

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This 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. Windows.
  2. Doors.
  3. Glazed entrances.
  4. Interior borrowed lites.
  5. Storefront framing.

1.3 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- C. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- D. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for 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.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of

sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
  - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300.

#### 1.5 SUBMITTALS

- A. Concurrent Review Requirements: Submit submittals of this section with other sections requiring glazing specified in this section.
  - 1. Division 8 Section "Aluminum-Framed Entrances and Storefronts."
- B. Product Data: For each glass product and glazing material indicated.
- C. Samples: For each glazing products, in the form of 12-inch- square Samples for glass and of 12-inch- long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
  - 1. Insulating glass for each designation indicated.
- D. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
  - 1. List by windows and door types scheduled on Drawings.
- E. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
  - 1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.
- F. Qualification Data: For installers.
- G. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.
- H. Product Test Reports: For each types of glazing products specified.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

- B. Source Limitations for Glass: Obtain glazing products through one source from a single manufacturer for each glass type as practical.
- C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- D. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
  - 1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- E. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
  - 1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
  - 2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
- F. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.
  - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency or manufacturer acceptable to authorities having jurisdiction.
  - 2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.
- G. 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:
    - a. GANA's "Glazing Manual."
  - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
- H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
  - 1. Insulating Glass Certification Council.
  - 2. Associated Laboratories, Inc.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

## 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 liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

## 1.9 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: 10 years.
- B. 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: 10 years.
- C. Installer's Warranty: 1 year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Non-Fire-Rated Glass Manufacturers: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  - 1. PPG (Basis of Design).
  - 2. Guardian.
  - 3. Pilkington.
  - 4. Visteon.
  - 5. Or equal.

- B. Non-Fire-Rated Glazing Fabricators: Subject to compliance with requirements, provide either the named fabricator or an equal fabricator by one of the other fabricators specified.
  - 1. Oldcastle Glass. (Basis of Design)
  - 2. Viracon.
  - 3. Guardian.
  - 4. Or equal.

## 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 (Safety Glass): ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
  - 1. For uncoated glass, comply with requirements for Condition A.
  - 2. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
  - 3. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.
- C. Clear Insulating-Glass Units: Insulated glass units. Low-e with glass to elastomer edge seal. Outer pane of clear glass, inner pane of clear glass. Place reflective coating on No.2 surface within the unit.
  - 1. Product: Solarban 60 (low -e coating) by PPG (Basis of Design).
    - a. Transmittance:
      - 1) Ultraviolet: 19%.
      - 2) Visible: 70%.
      - 3) Total Solar Energy: 33%.
    - b. Reflectance:
      - 1) Visible Light: 11%.
      - 2) Total Solar Energy: 30%.
    - c. U-Value:
      - 1) Winter Nighttime: 0.29.
      - 2) Summer Daytime: 0.27.
    - d. Shading Coefficient (SC): 0.44.
    - e. Solar Heat Gain Coefficient (SHGC): 0.38.
    - f. Light to Solar Gain (LSG): 1.85.
    - g. Low Emissivity Coating: e=0.05.
  - 2. Overall Unit Thickness and Thickness of Each Lite: 1 and 1/4 inch.
  - 3. Interspace Content: Air.
  - 4. Outdoor Lite: Class 1 (clear) HS glass.
  - 5. Indoor Lite: Class 1 (clear) HS glass.

## 2.3 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of material complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:



## 2.4 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
  - 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

## 2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive.

## 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 with a Shore, Type A durometer 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).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## 2.7 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze 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.
- B. Grind smooth and polish exposed glass edges and corners.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing glazing, 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 system.
  - 3. Minimum required face or 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.

### 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. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- 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. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

- E. 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.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
  - 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.
- H. 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.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

#### 3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant where indicated.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.5 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

### 3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.7 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

### 3.8 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, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

- 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 092900 - GYPSUM BOARD

### 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 the following:
  - 1. Interior gypsum board.
- B. Related Sections include the following:
  - 1. Division 6 Section "Sheathing" for gypsum sheathing.
  - 2. Division 7 Section "Building Insulation" for insulation and vapor retarders installed in assemblies that incorporate gypsum board.
  - 3. Division 9 Section "Painting" for primers and finishes applied to gypsum board surfaces.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For the following products:
  - 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.
  - 2. Finishes: Level 4 of gypsum board finish indicated for use in exposed locations. 4 by 4 foot sample.
    - a. Finishes: For each finish indicated and on same backing indicated for Work.

#### 1.4 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency acceptable to DSA.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

- C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Install mockups for the following:
    - a. Each level of gypsum board finish indicated for use in exposed locations.
    - b. Each finish indicated.
    - c. Each areas such as walls, ceilings, and soffits.
  - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
  - 3. Simulate finished lighting conditions for review of mockups.
  - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.5 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of gypsum board that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 1 year.
- B. Installer's Warranty: 1 year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Interior Gypsum Board: Subject to compliance with requirements, provide products by one of the following:
  - 1. USG Corporation.
  - 2. National Gypsum Company.
  - 3. G-P Gypsum.
  - 4. Or equal.
  
- B. Steel Trim Accessories: Subject to compliance with requirements, provide products by one of the following:
  - 1. USG Corporation.
  - 2. Amico.
  - 3. Or equal.
  
- C. Aluminum Trim: Subject to compliance with requirements, provide products by one of the following:
  - 1. Fry Reglet Corp.
  - 2. Flannery, Inc.
  - 3. Gordon, Inc.
  - 4. Pittcon Industries.
  - 5. Brand X Metals, Inc.
  - 6. Or equal.

### 2.2 PANELS, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### 2.3 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36 or ASTM C 1396, as applicable to type of gypsum board indicated and whichever is more stringent.
  
- B. Type X:
  - 1. Thickness: 5/8 inch.
  - 2. Long Edges: Tapered.
  
- C. Water-Resistant Gypsum Backing Board: ASTM C 630 or ASTM C 1396.
  - 1. Core: 5/8 inch, Type X.
  - 2. Use: Toilet rooms and janitor's closets walls with painted finish.
  - 3. Products:
    - a. USG Mold Tough Firecode Core Gypsum Panels by USG.
    - b. Gold Bond Brand Moisture-Resistant Fire Resistant Gypsum Board by National Gypsum.



- c. Or equal.
- 4. When Water-Resistant Gypsum Backing Boards are not available (gradual phasing out by manufacturers), provide Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
  - a. USG Mold Tough Firecode Core Gypsum Panels by USG.
  - b. XP Wallboard by National Gypsum.
  - c. DensArmor Interior Guard by G-P.
  - d. Or equal.

## 2.4 TRIM ACCESSORIES

- A. Trim: ASTM C 1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
  - 2. Shapes:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - d. L-Bead: L-shaped; exposed long flange receives joint compound.
    - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - f. Expansion (control) joint.
    - g. Curved-Edge Cornerbead: With notched or flexible flanges.
- B. Aluminum Trim and Reveal: As specified in Division 9 Section "Portland Cement Plaster".

## 2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape: Paper.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Sealants shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.

## 2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- C. Acoustical Sealant: Sheetrock Acoustical Sealant by USG or equal.
  - 1. Sealants shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.
- D. Thermal and Acoustical Insulation: As specified in Division 7 Section "Building Insulation."

- E. Gypsum Board Adhesives:
  - 1. High performance latex-based construction adhesive designed for gypsum board applications.
  - 2. Adhesives shall comply with South Coast Air Quality Management District (SCAQMD) Rule 1168.
  - 3. Products:
    - a. Green Series SW-325 Shear & Drywall Adhesive by OSI.
    - b. Drywall Adhesive GDWA by Grabberman.
    - c. Or equal.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Install gypsum board on the interior side of skylight well as indicated on Drawings.
- H. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members, or provide control joints to counteract wood shrinkage.

### 3.3 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  1. Cornerbead: Use at outside corners, unless otherwise indicated.
  2. LC-Bead: Use at exposed panel edges.
  3. L-Bead: Use where indicated.
  4. U-Bead: Use at exposed panel edges.
  5. Curved-Edge Cornerbead: Use at curved openings.
- D. Aluminum Trim: Install in locations indicated on Drawings Insert requirements.

### 3.4 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

- D. Gypsum Board Finish Levels: Comply with GA 214 for Level definitions.
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for ceramic tile or acoustical tile.
  - 3. Level 3: Where indicated on Drawings.
  - 4. Level 4: At panel surfaces that will be exposed to view with flat paint finish.
    - a. Primer and its application to surfaces are specified in other Division 9 Sections.

### 3.5 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

## SECTION 093000 - TILING

### 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 the following:
  - 1. Ceramic mosaic tile.
  - 2. Solid polymer thresholds installed as part of tile installations.
  - 3. Waterproof membrane for tile installations.
  - 4. Cementitious backer units installed as part of tile installations.
- B. Related Sections include the following:
  - 1. Division 9 Section "Gypsum Board" for moisture resistant gypsum board.

#### 1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
  - 1. Propose locations of expansion, contraction, control, and isolation joints if not indicated on Drawings.

- C. Installation Method: Show TCA installation method number for each tiled area in tabulated form.
- D. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.
- E. Product Certificates: For each type of product, signed by product manufacturer.
- F. Qualification Data: For Installer.
- G. Material Test Reports: For each tile-setting and -grouting product.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.
  - 1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of ceramic tile and accessories that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 1 year.

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Construction Documents

- B. Installer's Warranty: 1 year.

1.9 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.
  - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Ceramic Tile: Subject to compliance with requirements, provide products by one of the following manufacturers.
  - 1. Daltile; Div. of Dal-Tile International Inc. (Basis of Design)
  - 2. American Olean; Div. of Dal-Tile International Corp.
  - 3. Crossville Ceramics Company, L.P.
  - 4. Interceramic.
  - 5. Or equal.
- B. Solid-Polymer Thresholds: Subject to compliance with requirements, provide products by one of the following manufacturers.
  - 1. Avonite, Inc.
  - 2. DuPont Polymers.
  - 3. Formica Corporation.
  - 4. Nevamar; International Paper; Decorative Products Division.
  - 5. Or equal.
- C. Setting, Grouting Materials: Subject to compliance with requirements, provide products by one of the following manufacturers.
  - 1. Custom Building Products.
  - 2. LATICRETE International Inc.
  - 3. MAPEI Corporation.
  - 4. Omega.
  - 5. Or equal.
- D. Fluid Applied Waterproofing and Crack Suppression for Tile Installation: Subject to compliance with requirements, provide products by one of the following manufacturers.
  - 1. MAPEI Corporation; Mapelastic 315.
  - 2. Custom Building Products; RedGard.
  - 3. LATICRETE International Inc.; Laticrete 9235 Waterproof Membrane.
  - 4. Or equal.
- E. Cementitious Backer Board: Subject to compliance with requirements, provide products by one of the following manufacturers.
  - 1. USG Corporation; DUROCK Cement Board.
  - 2. National Gypsum Company; PermaBase.
  - 3. C-Cure; C-Cure Board 990.

Window Rock Office Building and Site  
Construction Documents

4. Custom Building Products; Wonderboard.
  5. Or equal.
- F. Metal Edge Strips: Subject to compliance with requirements, provide products by one of the following manufacturers.
1. Schluter Systems (Basis of Design).
  2. Blanke.
  3. Or equal.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
1. Provide tile complying with Standard grade requirements.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.
- C. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.3 TILE PRODUCTS

- A. Floor Tile: Per Owner Specification.
- B. Wall Tile: Per Owner Specification.
- C. Trim Units: Matching field tiles.



## 2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
- B. Solid Polymer Thresholds: Made from homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without precoated finish.

## 2.5 FLUID-APPLIED WATERPROOFING AND CRACK SUPPRESSION FOR TILE INSTALLATIONS

- A. General: Manufacturer's standard product that complies with ANSI A118.10.
- B. Fabric-Reinforced, Fluid-Applied Product: System consisting of liquid-latex rubber, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), and fabric reinforcement.

## 2.6 SETTING AND GROUTING MATERIALS

- A. Epoxy Adhesive: ANSI A136.1, Type I, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 1. Products:
    - a. Latipoxy epoxy adhesive.
    - b. MAPEI: Type 1.
    - c. Laticrete.
    - d. Custom Building Products.
    - e. Or equal.
- B. Chemical-Resistant, Water-Cleanable, Grouting Epoxy: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F and 212 deg F, respectively, and certified by manufacturer for intended use.
  - 2. Products:
    - a. Laticrete "2000 IG."
    - b. MAPEI: Kerapoxy IEG.
    - c. SpectraLock Pro by Laticrete.
    - d. Custom Building Products: 100% Solids Epoxy Grout.
    - e. Or equal.

## 2.7 ELASTOMERIC SEALANTS

- A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants."

1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

## 2.8 CEMENTITIOUS BACKER UNITS

- A. Properties:
  1. Aggregated portland cement board with coated glass-mesh reinforcement scrim.
  2. Comply with ANSI A118.9.
  3. Pass ASTM E136 for non-combustibility.
  4. Thickness: 5/8 inch.
  5. Lengths: Maximum lengths available to minimize end-to-end butt joints.
- B. Joint Tape: Mesh type as recommended by backer unit manufacturer.
- C. Joint Compound: As recommended by backer unit manufacturer.

## 2.9 MOISTURE AND MOLD-RESISTANT GYPSUM BOARD

- A. Comply with requirements of Division 9 Section "Gypsum Board".
- B. Substrates for painted surfaces in toilet rooms. Do not use as substrate for tile application.

## 2.10 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications, in aluminum finishes selected by Architect.
  1. Outside Corners: ECK-E by Schluter or equal.
  2. Exposed Edges: JOLLY by Schluter or equal.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

## 2.11 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.

- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
  - 1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
    - a. Sub-floor and Vertical Surfaces: 1/4 inch in 10 feet.
  - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
  - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
- B. Provide concrete substrates for tile floors installed with mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
  - 1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
  - 2. Remove protrusions, bumps, and ridges by sanding or grinding.
- C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

#### 3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
- F. Lay out tile wainscots to next full tile beyond dimensions indicated.
- G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
  - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
- H. Grout tile to comply with requirements of the following tile installation standards:
  - 1. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

### 3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

- A. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

### 3.5 FLOOR TILE INSTALLATION

- A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.
- B. Joint Widths: 1/8 inch unless specified otherwise.
- C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.6 WALL TILE INSTALLATION

- A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.
- B. Joint Widths: 1/8 inch unless specified otherwise.

3.7 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
  - 1. Remove epoxy grout residue from tile as soon as possible.
  - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
- B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 093000

## SECTION 095100 – ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION OF WORK

- A. Related work specified elsewhere:
  - 1. Mechanical equipment: Section 23 05 00
  - 2. Electrical: Section 16 05 00
  - 3. Gypsum board systems: Section 09 29 00

#### 1.2 SYSTEM DESCRIPTION

- A. Standard Panels: Suspended (Non Fire-Rated) ceiling system consisting of acoustical panel ceiling suspension system. System shall be rated NRC 0.70 in accordance with ASTM C423 and CAC 35 in accordance with ASTM test method E1414 and classification E413 as tested by an independent agency.

CAC: Ceiling Attenuation Class.

LR: Light Reflectance coefficient.

NRC: Noise Reduction Coefficient.

Recycled Content: Average percentage based on weight of component materials. Material recovered or diverted from the solid waste stream, either during the manufacturing process (pre-consumer) or after consumer use (post-consumer).

Sound Masking: Ceiling system to include Lencore sound masking with appropriate system customization to accommodate zoned masking and/or paging..

#### 1.3 DELIVERY AND STORAGE OF MATERIALS

- A. All materials shall be delivered in their original unopened packages and stored in an enclosed shelter providing protection from damage and exposure to the elements.
- B. Storage time of materials at the jobsite should be as short as possible, and environmental conditions should be as near as possible to those specified for occupancy (see no. 1.04 below). Excess humidity during storage can cause expansion of material and possible warp, sag, or poor fit after installation. Chemical changes in the mat and/or coatings can be aggravated by excess humidity and cause discoloration during storage, even in unopened cartons. Cartons should be removed from pallets and stringers to prevent distortion of material. Long term (6-12 months) storage under uncontrolled environmental conditions should be avoided.
- C. Damaged or deteriorated materials should be removed from the premises. Immediately before installation, to stabilize tile and panels, store them at a location where temperature and humidity conditions duplicate those ambient during installation and anticipated for occupancy.

#### 1.4 ENVIRONMENTAL CONDITIONS

- A. Installation of acoustical panels shall not begin until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from plaster, concrete, or terrazzo work has dissipated.
- B. Do not use ceiling panels in extreme or continuous high humidity, or areas exposed directly to weather or water. Ceiling panels are sized and designed for use within the standard occupancy range of temperature and humidity, 65-85 °F (18-29 °C), no more than 70% RH (relative humidity). Humidity can greatly affect product dimensional stability and sag resistance. Sag can become noticeable during periods of high humidity lasting only a few hours. ClimaPlus ceilings, if used with donn® brand suspension systems, can withstand temperatures up to 90-104 °F (32-40 °C) and relative humidity 95%-100% RH. See USG Interiors Inc. for standard Warranty information.
- C. Allow time for dimensional changes in ceiling panels stored at temperature/humidity conditions well outside of those recommended for service. With increases in temperature/humidity, these products expand (up to 1/64 in./ft. (4.3 mm/m) at 85 °F (29 °C)/90% RH) and may not fit into a fixed grid. Conversely, with decreases, these products will be undersize, but expand to normal when standard ambient conditions return.
- D. For some pattern edge details, if perimeter panels must be cut smaller, the cut edge must be field-rabbetted, or the wall angle must be lowered by Reveal Depth.

#### 1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: To obtain Lifetime ceiling system warranty, 30 year ceiling system warranty, color match or ceiling panel and suspension system compatibility, all acoustical panel and suspension system components shall be produced and supplied by one manufacturer. Materials supplied by more than one manufacturer are not acceptable.
- B. Subcontractor qualifications: Installer shall have successful experience in the installation of suspended ceiling systems on projects with requirements similar to requirements specified.
- C. Requirements of regulatory agencies: Codes and regulations of authorities having jurisdiction.
- D. Source quality control:
  - 1. Test reports: Manufacturer will provide test certification for minimum requirements as tested in accordance with applicable industry standards and/or to meet performance standards specified by various agencies.
  - 2. Changes from system: System performance following any substitution of materials or change in assembly design must be certified by the manufacturer.

## 1.6 REFERENCE

- A. ASTM C635 and C636: Manufacturing of metal suspension systems and Installation of Suspended Ceilings.
- B. Underwriters Laboratories, Inc.: Fire Resistance Directory, Acoustical Materials (BYIT).
- C. ASTM E84: Surface Burning Characteristics Classification.
- D. ASTM E119: Fire Tests of Building Construction and Materials.
- E. ASTM C423: Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- F. CISCA Ceiling Systems Installation Handbook.
- G. ASTM E1414: For CAC Testing

## 1.7 SUBMITTALS

- A. Samples: Submit representative sample of color and finish of all exposed materials.
- B. Shop drawings:
  - 1. Reflected ceiling plans: Contractors shall submit a layout arrangement of ceiling design, dimensions and locations of related integrated lighting and air distribution components.
  - 2. Installation drawings: Detail complete installation including suspension system, installation of related lighting and air distribution components, access requirements, sound absorption requirements, and fire rating requirements when applicable.
  - 3. Manufacturer's data: Submit manufacturer's catalog cuts or standard drawings showing details of system with project conditions clearly identified and manufacturer's recommended installation instructions.
  - 4. Maintenance materials: Submit one percent of amount of ceiling components installed.
- C. Warranty: Manufacturer's standard warranty for extent of conditions allowable and duration of warranty.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling and suspension system.
  - 1. UL Acoustical Compliance: For acoustical performance, each carton of material must carry Underwriters Laboratories certification for CAC and NRC.
  - 2. UL Suspension System Load Compliance: Manufacturer must certify that the metal suspension system is UL Classified to be load compliant per ASTM C635. For load compliance, each carton of main tees must carry Underwriters Laboratories certification for load compliance.



1.8 PROJECT CONDITIONS

- A. Existing conditions: As specified on construction drawings.
- B. Environmental requirements for interior installation: Building shall be enclosed with windows and exterior doors in place and glazed, and roof watertight before installation of ceiling system and related ceiling components. Climatic condition range of 60-85 °F (16-29 °C) with a max 70% RH.
- C. Coordination with other work:
  - 1. Mechanical work: Ductwork above ceiling shall be complete, and permanent heating and cooling systems operating to climate conditions prior to installation of ceiling components.
  - 2. Electrical work: Installation of conduit above ceiling shall be complete before installation of ceiling components.
  - 3. Fire protection work: Fire protection lines and/or equipment occurring above ceiling shall be completed and tested before ceiling components are installed.
- C. Protection: Protect completed work above ceiling system from damage during installation of ceiling components.

PART 2 – PRODUCTS

2.1 INSPECTION

- A. Ceiling panels as manufactured by USG Interiors, Inc., Ceilings Division, Chicago, Illinois, U.S.
- B. Sound masking, as manufactured by Lencore Acoustics Corp., Woodbury, New York, U.S.A.1
- C. Fill in the following information for the product you want to specify (see Color Selector, SC1859, for color numbers):

Pattern Name	Item No.	Color No.	Plastic Coating <sup>2</sup>	Sound Masking
Eclipse	78575	white	No	Yes

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine areas to receive ceiling panels for conditions that will adversely affect installation. Provide written report of discrepancies.
- B. Do not start work until unsatisfactory conditions are corrected.
- C. Work to be concealed: Verify work above ceiling is complete and installed in manner that will not affect layout and installation of ceiling panels.
- D. Beginning of installation shall signify acceptance of conditions in areas to receive ceiling panels.
- E. Fire-rating requirements: Construction above fire-rated assembly shall meet requirements of UL Design specified in 2: Products

3.2 PREPARATION

- A. Field dimensions must be verified prior to installation.

3.3 INSTALLATION

- A. Standard reference: Install ceiling panels and suspension system, including necessary hangers, grillage, splines, and other supporting hardware, in accordance with ASTM C636, CISCA Installation Syds., (UL Design) and any applicable code requirement.

- B. Manufacturer's reference: Install ceiling panels in exposed grid systems, supported on all edges, in accordance with manufacturer's current printed recommendations.
- C. Drawing reference: Install ceiling panels in accordance with approved shop drawings.

#### 3.4 MAINTENANCE

- A. Cleaning: Panels can be cleaned easily with a soft brush, vacuum, or dry chemical sponge.
- B. Repainting: Spray a thinned, nonbridging vinyl-acrylic flat wall paint. The type of paint selected and the method of application can alter the acoustical performance and fire ratings of any acoustical product. Therefore, USG Interiors, Inc. cannot guarantee that the field-painted panels will match the published performance.

END OF SECTION 095100

## SECTION 096513 - RESILIENT WALL BASE AND ACCESSORIES

### 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 the following:
  - 1. Wall base.
  - 2. Molding accessories.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

#### 1.4 QUALITY ASSURANCE

- A. Pre-Molded Corners: Pre-molded inside and outside rubber base corners shall be from same production run as straight base. These are commonly from different production run and as result are different color shades. This color difference often negates premium appearance of pre-molded products.
- B. Fire-Test-Response Characteristics: Provide resilient stair accessories with a critical radiant flux classification of Class I, not less than 0.45 W/sq. cm, as determined by testing identical products per ASTM E 648 by a testing and inspecting agency acceptable to authorities having jurisdiction.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

## 1.6 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of resilient wall base and accessories that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 1 year.
- B. Installer's Warranty: 1 year.

## 1.8 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.
  - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Type TP Resilient Wall Base: Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.
  - 1. Burke Mercer Flooring Products. (Basis of Design)
  - 2. Allstate Rubber.
  - 3. Armstrong.
  - 4. Johnsonite.
  - 5. Or equal.

### 2.2 RESILIENT WALL BASE

- A. Product: Type TP Colonial Base by Burke.

1. Thermoplastic Rubber Wall Base: Colonial Rubber Base Type - TP
2. Co-extruded thermoplastic rubber, thickness, matte finish; ASTM F1861, Type TP, Group 1, Styles A & B.
3. Style: 4-1/4 inch height, Art Deco, 3/16 inch thick.
4. Profile: Cove.
5. Style and Colors: As selected by Architect from manufacturer's full range.

### 2.3 RESILIENT MOLDING ACCESSORY

- A. Types:
  1. Reducer strip for resilient floor covering
  2. Joiner for tile and carpet.
- B. Material: Rubber.
- C. Profile and Dimensions: As indicated.

### 2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturers for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
  1. Rubber Floor Adhesives: 60 g/L.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
  1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
  2. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Concrete Substrates:
  1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
  - 1. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- F. Premolded Corners: Install premolded corners before installing straight pieces.
- G. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
  - 4. Do not wash surfaces until after time period recommended by manufacturer.
  
- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 096513



## SECTION 096800 - CARPETING

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Section specifies carpet, edge strips, adhesives, and other items required for complete installation.

#### 1.2 RELATED WORK

- A. Color and texture of carpet and edge strip: PER OWNER SPECIFICATION
- B. Resilient wall base: Section 09 65 13, RESILIENT BASE AND ACCESSORIES.

#### 1.3 QUALITY ASSURANCE

- A. Carpet installed by mechanics certified by the Floor Covering Installation Board.
- B. Certify and label the carpet that it has been tested and meets criteria of CRI IAQ Carpet Testing Program for indoor air quality.

#### 1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data:
  - 1. Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading and flame resistance characteristics for each type of carpet material and installation accessory.
  - 2. Manufacturer's printed installation instructions for the carpet, including preparation of installation substrate, seaming techniques and recommended adhesives and tapes.
  - 3. Manufacturer's certificate verifying carpet containing recycled materials include percentage of recycled materials as specified.
- C. Samples:
  - 1. Carpet: "Production Quality" samples 300 x 300 mm (12 x 12 inches) of carpets, showing quality, pattern and color specified by owner.
  - 2. Floor Edge Strip (Molding): 150 mm (6 inches) long of each color and type specified.
  - 3. Base Edge Strip (Molding): 150 mm (6 inches) long of each color specified.
- D. Shop Drawings: Installers layout plan showing seams and cuts for sheet carpet and carpet module.

- E. Maintenance Data: Carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods and cleaning cycles.

1.5 DELIVERY AND STORAGE

- A. Deliver carpet in manufacturer's original wrappings and packages clearly labeled with manufacturer's name, brand, name, size, dye lot number and related information.
- B. Deliver adhesives in containers clearly labeled with manufacturer's name, brand name, number, installation instructions, safety instructions and flash points.
- C. Store in a clean, dry, well ventilated area, protected from damage and soiling. Maintain storage space at a temperature above 16 degrees C (60 degrees F) for 2 days prior to installation.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Areas in which carpeting is to be installed shall be maintained at a temperature above 16 degrees C (60 degrees F) for 2 days before installation, during installation and for 2 days after installation. A minimum temperature of 13 degrees C (55 degrees F) shall be maintained thereafter for the duration of the contract. Traffic or movement of furniture or equipment in carpeted area shall not be permitted for 24 hours after installation. Other work which would damage the carpet shall be completed prior to installation of carpet.

1.7 WARRANTY

- A. Carpet and installation subject to terms of "Warranty of Construction" FAR clause 52.246-21, except that warranty period is extended to two years.

1.8 APPLICABLE PUBLICATIONS

- A. Publication listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American National Standards Institute (ANSI):  
ANSI/NSF 140-10 .....Sustainable Carpet Assessment Standard
- C. American Association of Textile Chemists and Colorists (AATCC):  
AATCC 16-04 ..... Colorfastness to Light  
AATCC 129-10..... Colorfastness to Ozone in the Atmosphere under High Humidities  
AATCC 134-11..... Electric Static Propensity of Carpets  
AATCC 165-08..... Colorfastness to Crocking: Textile Floor Coverings-AATCC  
Crockmeter Method

- D. American Society for Testing and Materials (ASTM):
  - ASTM D1335-05 ..... Tuft Bind of Pile Yarn Floor Coverings
  - ASTM D3278-96 (R2004).... Flash Point of Liquids by Small Scale Closed-Cup Apparatus
  - ASTM D5116-10 ..... Determinations of Organic Emissions from Indoor  
Materials/Products
  - ASTM D5252-05 ..... Operation of the Hexapod Tumble Drum Tester
  - ASTM D5417-05 ..... Operation of the Vettermann Drum Tester
  - ASTM E648-10..... Critical Radiant Flux of Floor-Covering Systems Using a Radiant  
Heat Energy Source
- E. The Carpet and Rug Institute (CRI):
  - CRI 104-11 ..... Installation of Commercial Carpet

## PART 2 - PRODUCTS

### 2.1 CARPET

- A. Physical Characteristics:
  - 1. Carpet free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains and other physical and manufacturing defects.
  - 2. Manufacturers standard construction commercial carpet:
    - a. Broadloom; maximum width to minimum use
    - b. Modular Tile: 660 mm (24 inches) square tile.
  - 3. Provide static control to permanently control static build up to less than 2.0 kV when tested at 20 percent relative humidity and 21 degrees C (70 degrees F) in accordance with AATCC 134.
  - 4. Pile Height: Maximum 3.25 mm (0.10 inch).
  - 5. Pile Fiber: Nylon with recycled content 25 percent minimum branded (federally registered trademark).
  - 6. Pile Type: Level Loop.
  - 7. Backing materials: Manufacturer's unitary backing designed for glue-down installation using recovered materials.
  - 8. Appearance Retention Rating (ARR): Carpet shall be tested and have the minimum 3.5-4.0 Severe ARR when tested in accordance with either the ASTM D 5252 (Hexapod) or

ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified.

9. Tuft Bind: Minimum force of 40 N (10 lb) required to pull a tuft or loop free from carpet backing. Test per ASTM D1335.
  10. Colorfastness to Crocking: Dry and wet crocking and water bleed, comply with AATCC 165 Color Transference Chart for colors, minimum class 4 rating.
  11. Colorfastness to Ozone: Comply with AATCC 129, minimum rating of 4 on the AATCC color transfer chart.
  12. Delamination Strength: Minimum of 440 N/m (2.5 lb/inch) between secondary backing.
  13. Flammability and Critical Radiant Flux Requirements:
    - a. Test Carpet in accordance with ASTM E 648.
    - b. Class I: Not less than 0.45 watts per square centimeter.
    - c. Class II: Not less than 0.22 watts per square centimeter.
    - d. Carpet in corridors, exits and Medical Facilities: Class I.
  14. Density: Average Pile Yarn Density (APYD):
    - a. Corridors, lobbies, entrances, common areas or multipurpose rooms, open offices, waiting areas and dining areas: Minimum APYD 6000.
    - b. Other areas: Minimum APYD 4000.
  15. VOC Limits: Use carpet and carpet adhesive that comply with the following limits for VOC content when tested according to ASTM D 5116:
    - a. Carpet, Total VOCs: 0.5 mg/sq.m x hr.
    - b. Carpet, 4-PC (4-Phenylcyclohexene): 0.05 mg/sq.m x hr.
    - c. Carpet, Formaldehyde: 0.05 mg/sq.m x hr.
    - d. Carpet, Styrene: 0.4 mg/sq.m x hr.
    - e. Adhesive, Total VOCs: 10.00 mg/sq.m x hr.
    - f. Adhesive, Formaldehyde: 0.05 mg/sq.m x hr.
    - g. Adhesive, 2-Ethyl-1-Hexanol: 3.00 mg/sq.m x hr.
- B. Shall meet platinum level of ANSI/NSF 140.
- C. Color, Texture, and Pattern: As specified by owner.

## 2.2 ADHESIVE AND CONCRETE PRIMER

- A. Waterproof, resistant to cleaning solutions, steam and water, nonflammable, complies with air-quality standards as specified. Adhesives flashpoint minimum 60 degrees C (140 degrees F), complies with ASTM D 3278.
- B. Seam Adhesives: Waterproof, non-flammable and non-staining.

## 2.3 SEAMING TAPE

- A. Permanently resistant to carpet cleaning solutions, steam, and water.
- B. Recommended by carpet manufacturer.

## 2.4 EDGE STRIPS (MOLDING)

- A. Metal:
  - 1. Hammered surface aluminum, pinless, clamp down type designed for the carpet being installed.
  - 2. Floor flange not less than 38 mm (1-1/2 inches) wide, face not less than 16 mm (5/8 inch) wide.
  - 3. Finish: Clear anodic coating unless specified otherwise by owner.
- B. Vinyl Edge Strip:
  - 1. Beveled floor flange minimum 50 mm (2 inches) wide.
  - 2. Beveled surface to finish flush with carpet for tight joint and other side to floor finish.
  - 3. Color as specified by owner.
- C. Carpet Base Top Edge Strip:
  - 1. Vinyl "J" strip wall flange minimum of 38 mm (1-1/2 inches) wide with cap beveled from wall to finish flush with carpet being installed.
  - 2. Color as specified by owner.

2.5 LEVELING COMPOUND (FOR CONCRETE FLOORS)

- A. Provide Portland cement bases polymer modifier with latex or polyvinyl acetate resin manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.
- B. Determine the type of underlayment selected for use by condition to be corrected.

PART 3 – EXECUTION

3.1 SURFACE PREPARATION

- A. Examine surfaces on which carpeting is to be installed.
- B. Clean floor of oil, waxy films, paint, dust and deleterious substances that prevent adhesion, leave floor dry and cured, free of residue from curing or cleaning agents.
- C. Correct conditions which will impair proper installation, including trowel marks, pits, dents, protrusions, cracks or joints.
- D. Fill cracks, joints depressions, and other irregularities in concrete with leveling compound.
  - 1. Do not use adhesive for filling or leveling purposes.
  - 2. Do not use leveling compound to correct imperfections which can be corrected by spot grinding.
  - 3. Trowel to smooth surface free of trowel marks, pits, dents, protrusions, cracks or joint lines.
- D. Test new concrete subfloor prior to adhesive application for moisture and surface alkalinity per CRI 104 Section 6.3.1 or per ASTM E1907.

3.2 CARPET INSTALLTION

- A. Do not install carpet until work of other trades including painting is complete and dry.

- B. Install in accordance with CRI 104 direct glue down installation.
  - 1. Relax carpet in accordance with Section 6.4.
  - 2. Comply with indoor air quality recommendations noted in Section 6.5.
  - 3. Maintain temperature in accordance with Section 15.3.
  
- C. Secure carpet to subfloor of spaces with adhesive applied as recommended by carpet manufacturer.
  
- D. Follow carpet manufacturer's recommendations for matching pattern and texture directions.
  
- E. Cut openings in carpet where required for installing equipment, pipes, outlets, and penetrations.
  - 1. Bind or seal cut edge of sheet carpet and replace flanges or plates.
  - 2. Use additional adhesive to secure carpets around pipes and other vertical projections.
  
- G. Broadloom Carpet:
  - 1. Install per CRI 104, Section 8.
  - 2. Lay broadloom carpet lengthwise in longest dimension of space, with minimum seams, uniformly spaced to provide a tight smooth finish, free from movement when subjected to traffic.
  - 3. Use tape-seaming method to join sheet carpet edges. Do not leave visible seams.
  
- H. Carpet Modules:
  - 1. Install per CRI 104, Section 13, Adhesive Application.
  - 2. Lay carpet modules with pile in same direction unless specified otherwise by owner.
  - 3. Install carpet modules so that cleaning methods and solutions do not cause dislocation of modules.
  - 4. Lay carpet modules uniformly to provide tight flush joints free from movement when subject to traffic.

### 3.3 EDGE STRIPS INSTALLATION

- A. Install edge strips over exposed carpet edges adjacent to uncarpeted finish flooring.
- B. Anchor metal strips to floor with suitable fasteners. Apply adhesive to edge strips, insert carpet into lip and press it down over carpet.
- C. Anchor vinyl edge strip to floor with adhesive apply adhesive to edge strip and insert carpet into lip and press lip down over carpet.
- D. Carpet Base Top Edge Strip Installation:
  - 1. Place carpet molding at top edge of carpet where turned up as base.
  - 2. Install molding in accordance with manufacturer's instructions.

### 3.4 PROTECTION AND CLEANING

- A. Remove waste, fasteners and other cuttings from carpet floors.
- B. Vacuum carpet and provide suitable protection. Do not use polyethylene film.
- C. Do not permit traffic on carpeted surfaces for at least 48 hours after installation. Protect the carpet in accordance with CRI 104.
- D. Do not move furniture or equipment on unprotected carpeted surfaces.
- E. Just before final acceptance of work, remove protection and vacuum carpet clean.

END OF SECTION 096800



## SECTION 099100 - 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 the following:
  - 1. Surface Preparation.
  - 2. Field application of paints, stains, varnishes, and other coatings.
  - 3. See Schedule - Surfaces to be finished, at end of Section.

#### 1.3 SUBMITTALS

- A. Product data - Submit product data sheets for each product.
- B. Samples:
  - 1. Submit two painted samples, illustrating selected colors and textures for each color and systems selected with specified coats cascaded.
  - 2. Submit on suitable backing, 8x10 inch size.

#### 1.4 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

#### 1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Provide lighting level of 80 ft candles measured mid-height at substrate surface.
- C. Environment Requirements:
  - 1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be stored and applied.

Window Rock Office Building and Site  
Construction Documents

2. Do not paint when there is a threat of rain within 24 hours or when surface or air temperatures are at or below 40 degrees.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace paint that fails in materials or workmanship within specified warranty period.
  1. Warranty Period: 1 year.
- B. Installer Warranty: 1 year.

1.7 EXTRA STOCK

- A. Provide following:
  1. Minimum 1 gallon each product in original or new 1 gallon cans.
    - a. Color spot each lid.
    - b. Identify with formula, location, product and date.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Paints: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  1. Sherwin Williams. (Basis of Design)
  2. Dunn-Edwards.
  3. Glidden (ICI) Paints.
  4. Frazee Paint.
  5. Vista Paint.
  6. Or equal.

2.2 PAINTS AND COATINGS

- A. Ready mixed, except field-catalyzed coatings.
- B. Prepare pigments:
  1. To a soft paste consistency, capable of being readily and uniformly dispersed to a homogenous coating.
  2. For good flow and brushing properties.
  3. Capable of drying or curing free of streaks or sags.

PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application. Do not proceed unless substrate is suitable.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  - 1. Plaster and Gypsum Wallboard: 12 percent.
  - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent
  - 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
  - 4. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

### 3.2 PREPARATION OF SURFACE

- A. General:
  - 1. Clean all exterior walls and surfaces of loose and scaly paint, dirt, dust, chalk, and other foreign matter by water-blasting using care not to damage substrate followed by hand scraping, sanding or wire brushing after surfaces are dry. Mildew must be treated with household bleach solution and rinsed thoroughly.
  - 2. Patch, caulk, set protruding nails and repair all surfaces and cracks where necessary with suitable patching materials and smooth off to match adjacent surfaces.
  - 3. Sand Glossy surfaces to dull surface and remove residue.
  - 4. Remove mildew from affected surfaces with a solution of Tri-Sodium Phosphate and bleach. Rinse with clean water and allow to dry completely.
  - 5. Remove soil and body oils completely from surfaces, including handrails, door edges and posts. Treat with Liquid Sandpaper or Dull-N-Bond.
  - 6. Remove hardware, accessories, plates, fixtures and similar items not to be finished. Reinstall at completion.
  - 7. Paint edges of sink cut-outs.
- B. Concrete Surfaces:
  - 1. Concrete surfaces shall be dry, clean and free from efflorescence, encrustations and other foreign matter. Any glazed surface shall be slightly roughened or etched. Curing compounds, bond breakers, release agents and other coatings shall be removed with a light sandblast or high pressure power wash.
- C. Ferrous Metal: Remove grease, rust, scale, dirt and dust from ferrous metal surfaces. Primer coat shall be applied not less than 30 minutes, nor more than 3 hours after preparation of surface.
- D. Primed Metal: Sand and scrape shop primed metal to remove loose primer and rust. Touch-up bare, abraded and damaged areas with metal primer. Feather edges to make touch-up patches inconspicuous.

- E. Wood Surfaces:
  - 1. Remove dust, grit and foreign matter from wood surfaces. Sand surfaces and dust clean. Spot prime knots, pitch streaks and sappy sections with a stain blocking primer where surfaces are to be painted. Fill nail holes, cracks and other defects after priming and spot prime repairs after patching material has fully cured.
  - 2. Wood surfaces with peeling areas are to have edges of broken paint film sanded to a feather edge.
  - 3. Back prime wood trim. Paint tops, bottoms, edges and cut-outs of doors.
- F. Plaster Surfaces:
  - 1. Plaster surfaces shall be dry and free from efflorescence, encrustations and foreign matter. Fill cracks, holes and imperfections, smoothing repairs to match adjacent texture. Allow repairs to fully cure before priming.
  - 2. Prime plaster surfaces with specified primer. Caulk all cracks.
- G. Gypsum Board: Gypsum board shall be dusted clean and free from encrustations and other foreign matter.
- H. Preparation of other surfaces shall be performed following specific recommendations of the coating manufacturer.

### 3.3 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless otherwise approved
- E. Sand wood surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust particles just prior to applying next coat.
- G. Stipple all edges and corners to conceal brush marks.

- H. Paint entire trim element with like color. Painting of faces only is unacceptable. Trim surfaces must be wrapped with the trim color and not "faced off" or "Hollywooded".
- I. Doors: Paint entire door unless otherwise noted, including door top and bottom edge surfaces.
- J. Tinting: Tint each primer a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint primer to match the color of the finish coat, but provide sufficient differences in shade of primer to distinguish each separate coat.

### 3.4 PROTECTION

- A. Protect work of other trades and items not intended to receive paint. Install "wet paint" signs to protect newly painted surfaces.

### 3.5 CLEANING

- A. Protection - Carefully protect areas where work is in progress from damage.
  - 1. Provide and spread clean drop cloths when and where required to provide the necessary protection.
  - 2. Immediately clean-up all accidental spatter, spillage, misplaced paint and restore the affected surface to its original condition.
- B. Clean-up:
  - 1. Clean up debris daily per OSHA requirements.
  - 2. At completion of work, remove all materials, supplies, debris and rubbish and leave each area in a clean, acceptable condition.
  - 3. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

### 3.6 SURFACES TO BE FINISHED

- A. Paint all new work and areas affected by new work, unless noted otherwise.
- B. Do not paint or finish the following items:
  - 1. Items fully factory-finished unless specifically noted.
  - 2. Fire rating labels, equipment serial number and capacity labels.
- C. Mechanical and Electrical: Use paint systems defined for the substrates to be finished.
  - 1. Paint all insulated and exposed pipes occurring in finished areas to match background surfaces, unless otherwise indicated.
  - 2. Paint shop primed items occurring in finished areas.
  - 3. Paint interior surfaces of air ducts and convectors and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint.
  - 4. Paint dampers exposed behind louvers, grilles and convectors and baseboard cabinets to match face panels.

### 3.7 PAINT SYSTEMS - EXTERIOR

- A. Plaster/Stucco, Opaque, Flat, Latex, 3 coat:
  - 1. 1 Coat: Loxon Masonry Primer A24W300.
  - 2. 2 Coats: A-100 Flat A6W851 (1.4 mils dft pr/ct).
- B. Ferrous Metals, Unprimed, Latex, 3 coat:
  - 1. 1 Coat: All Surface Enamel Primer A41W210.
  - 2. 2 Coats: Metalatex Semi-Gloss B42 Series.
- C. Galvanized Metals, Semi-Gloss, Alkyd, 3 coat:
  - 1. 1 Coat: Pro-Cryl Universal Primer B66-310.
  - 2. 2 Coats: WB Industrial Enamel Gloss B53-300.
- D. Wood and Composite Wood, Flat, Opaque, Latex, 3 coat:
  - 1. 1 Coat: A-100 Exterior Latex Primer B42W41.
  - 2. 2 Coats: A-100 Flat A6W851.
- E. Wood and Composite Wood, Semi-Gloss, Opaque, Latex, 3 coat:
  - 1. 1 Coat: A-100 Exterior Latex Primer B42W41.
  - 2. 2 Coats: Metalatex Semi-Gloss B42 Series.

### 3.8 PAINT SYSTEMS -INTERIOR

- A. Concrete Walls, Gloss, 3 coat:
  - 1. 1 Coat: Prep-Rite Masonry Primer B28W300.
  - 2. 2 Coats: Pro-Classic Latex Gloss B21W51.
- B. Concrete Walls, Eggshell , 3 coat:
  - 1. 1 Coat: Prep-Rite Masonry Primer B28W300.
  - 2. 2 Coats: Pro-Mar 200 Latex Egg-Shell B20W2200.
- C. Plaster, Eggshell, Latex, 3 coat:
  - 1. 1 Coat: Prep-Rite Masonry Primer B28W300.
  - 2. 2 Coats: Pro-Mar 200 Latex Egg-Shell B20W22.
- D. Ferrous Metals - Primed, Latex, 3 coat:

Window Rock Office Building and Site  
Construction Documents

1. 1 Coat: All Surface Enamel Primer B42W210.
  2. 2 Coats: Pro-Mar 200 Semi-Gloss B31W2200.
- E. Ferrous Metals - Unprimed, Latex, 3 coat:
1. 1 Coat: All Surface Enamel Primer B42W210.
  2. 2 Coats: Pro-Mar 200 Semi-Gloss B31W2200.
- F. Galvanized Metals, 3 coat:
1. Pretreat.
  2. 1 Coat: All Surface Enamel Primer B42W210.
  3. 2 Coats: Pro-Mar 200 Semi-Gloss B31W2200.
- G. Wood and Composite Wood, Semi-Gloss, Opaque, Latex, 3 coat:
1. 1 Coat: Prep-Rite Classic Primer B28W101.
  2. 2 Coats: Pro-Mar 200 Semi-Gloss B31W2200.
- H. Wood Clear Finish – Transparent, Acrylic Urethane, Stain, 3 coats:
1. 1 Coat: Wood Classics Int. Oil Stain A49 Series.
  2. 2 Coats: Wood Classics Polyurethane Varnish, Gloss or Satin A67 Series.
- I. Gypsum Board, Eggshell, Latex, 3 coat:
1. 1 Coat: Prep-Rite 200 Latex Primer B28W200.
  2. 2 Coats: Pro-Mar 200 Latex Egg-Shell B20W2200.

3.9 COLORS

- A. To be selected by Owner.

END OF SECTION 099100

## SECTION 101400 - SIGNAGE

### 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 the following:
  - 1. Panel signs (room signs).
  - 2. Parking signs.
  - 3. Signage accessories.

#### 1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.
- B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
  - 1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and braille layout.
- C. Samples for Initial Selection: For each type of sign material indicated that involves color selection.
- D. Samples for Verification: For each type of sign, include the following Samples to verify color selected:
  - 1. Panel Signs: Full-size Samples of each type of sign required.
  - 2. Approved samples will not be returned for installation into Project.
- E. Qualification Data: For Installer.
- F. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative of signage manufacturer for installation and maintenance of units required for this Project.



- B. Source Limitations: Obtain each sign type through one source from a single manufacturer.
- C. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

#### 1.6 COORDINATION

- A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.
  - 1. For signs supported by or anchored to permanent construction, furnish templates for installation of anchorage devices.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signage fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 1 year.
- B. Installer Warranty: 1 year.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Signs: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  - 1. Best Sign Systems Inc. (Basis of Design)
  - 2. ASI Sign Systems, Inc.
  - 3. Curcio Enterprises, Inc.
  - 4. Mohawk Sign Systems.
  - 5. Sign A Rama.
  - 6. Or equal.

#### 2.2 PANEL SIGNS

- A. General: Provide panel signs that comply with requirements indicated for materials,

thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

1. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally.

B. Product: HC300 ADA Sign System by Best Sign Systems.

1. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished.
2. Room, Occupancy, Wayfinding Signs: As selected from 4 standard copy size signs.
  - a. 4" x 2" with up to 4 characters each.
  - b. 6" x 2" with up to 8 characters each.
  - c. 8" x 2" with up to 12 characters each.
  - d. 10" x 2" with up to 14 characters each.
3. Toilet Room Signs: As selected from manufacturer's standard.
4. Symbols of Accessibility: Provide 6-inch- high symbol fabricated from opaque nonreflective vinyl film, 0.0035-inch nominal thickness, with pressure-sensitive adhesive backing suitable for both exterior and interior applications.
5. Material:
  - a. 1/4 inch thick (thicker than standard) "MP", acrylic sheet, ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
6. Tactile and Braille Copy: Manufacturer's standard. Produce precisely formed characters with square cut edges free from burrs and cut marks, use dome dots.
7. Copy: 5/8 inch Helvetica Medium with contracted grade 2 Braille all capital letter on tactile sign.

## 2.3 PARKING SIGNS

- A. Material: 0.063" aluminum, screen printed copy on engineer grade reflective vinyl sheeting.
  1. Text: Symbols of accessibility, accessible direction, etc. as indicated on Drawings.
- B. Accessible signs are blue with white symbol.
- C. Post: 2 inch diameter, schedule 40 galvanized pipe.

## 2.4 ACCESSORIES

- A. Mounting Methods: Use concealed fasteners fabricated from materials that are not corrosive to sign material and mounting surface.
- B. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

## 2.5 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 strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

## 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 work.
- B. Verify that items, including anchor inserts, provided under other sections of Work are sized and located to accommodate signs.
- C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.
  - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
  - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Panel Signs:
  - 1. Interior Signs on Smooth Substrates:
    - a. Silicone-Adhesive Mounting: Use liquid-silicone adhesive recommended in writing by sign manufacturer to attach signs to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended in writing by sign manufacturer to hold sign in place until adhesive has fully cured.
  - 2. Exterior and Interior Signs on Rough Substrates:

Window Rock Office Building and Site  
Construction Documents

- a. Mechanical Fasteners: Mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
  - 1) Fastener: Stainless steel screws, tamper-resistant flat head countersink.
  - 2) Anchors: Suitable for secure attachment to substrate.

C. Parking Signs

1. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
2. Install sign level, plumb, and at height indicated.
3. Cap post with galvanized cap.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 101400

## SECTION 102600 – WALL AND DOOR PROTECTION

### 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 the following:
  - 1. Corner guards.

#### 1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall-protection unit.
- B. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated.
  - 1. Include similar Samples of accent strips and accessories involving color selection.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
  - 1. Corner Guards: 12 inches long. Include examples of joinery, corners, and field splices.
- D. Warranty: Special warranty specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain impact-resistant wall-protection units through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall-protection units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
  - 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.

## 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-protection units that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Deterioration of plastic and other materials beyond normal use.
  - 2. Warranty Period: 5 years.
- B. Installer's Warranty: 1 year.

## 1.6 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.
  - 1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of units installed, but no fewer than two, 4-foot-long units.
- B. Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Corner Guards: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  - 1. IPC Door and Wall Protection Systems; Division of InPro Corporation. (Basis of Design)
  - 2. Construction Specialties (C/S), Inc.
  - 3. Balco, Inc.
  - 4. Korogard Wall Protection Systems; Division of RJF International Corporation.
  - 5. Pawling Corporation.
  - 6. Or equal.

### 2.2 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 240.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- C. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.

## 2.3 CORNER GUARDS

- A. Stainless Steel Corner Guards:
  - 1. Stainless Steel 90°/90° Bullnose 3.5 inch Wing by IPC.

## 2.4 FABRICATION

- A. Fabricate impact-resistant wall-protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

## 2.5 METAL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Remove tool and die marks and stretch lines or blend into finish.
  - 2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  - 1. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
  - 2. For impact-resistant wall-protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

### 3.3 INSTALLATION

- A. General: Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
  - 1. Install impact-resistant wall-protection units in locations and at mounting heights indicated on Drawings.
  - 2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
    - a. Provide anchoring devices to withstand imposed loads.
    - b. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.
    - c. Adjust end and top caps as required to ensure tight seams.

### 3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600



## SECTION 102800 - TOILET AND BATH ACCESSORIES

### 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:
  - 1. Toilet and bath accessories.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
  - 1. Construction details and dimensions.
  - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Material and finish descriptions.
  - 4. Features that will be included for Project.
  - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated on Drawings.
- C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

#### 1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace toilet and bath accessories that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 1 year.
- B. Installer's Warranty: 1 year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Toilet and Bath Accessories: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  - 1. Bobrick Washroom Equipment, Inc. (Basis of Design)
  - 2. American Specialties, Inc.
  - 3. Bradley Corporation.
  - 4. Or equal.
- B. Underlavatory Guards: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  - 1. Handy-Shield by Plumberex Specialty Products, Inc. (Basis of Design)
  - 2. IPS Corp.
  - 3. TCI Products.
  - 4. Truebro, Inc.
  - 5. Or equal.

### 2.2 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.
- C. Galvanized Steel Sheet: ASTM A 653, with G60 hot-dip zinc coating.
- D. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- H. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

### 2.3 TOILET TISSUE DISPENSER

- A. Product: Classic B-2888 by Bobrick.
1. Type: Surface mount, series multi-roll toilet tissue dispenser similar to B-4288, but door has flat face with protruding tumbler lock.
  2. Material: 18-8 S, type 304, 22-gage, satin-finish stainless steel with one-piece seamless construction.
  3. Holds two rolls up to 5-1•4" dia. (1800 sheets).
  4. Extra roll automatically drops in place when bottom roll is depleted.
  5. Theft-resistant, heavy-duty spindles.
  6. Unit: 6-1•16" W, 11" H, 5-15•16" D.

### 2.4 PAPER TOWEL DISPENSER

- A. Product: Classic B-262 ADA by Bobrick.
1. Type: Surface mount.
  2. Material: 18-8 S, type 304, 22-gage, satin-finish stainless steel.
  3. Dispenses 400 C-fold or 525 multifold towels measuring 3-1•8" to 3-13•16" deep without adjustment or adapters.
  4. Door: Tumbler lock and piano-hinge.
  5. Cabinet slots indicate refill time.
  6. Size: 10-3•4" W, 14" H, 4" D.

### 2.5 WASTE RECEPTACLE

- A. Product: B-2250 with cover by Bobrick or equal.
1. Description: Waste receptacle shall be 22-gauge (0.8mm) stainless steel. Exposed surfaces shall have satin finish. Waste receptacle shall be equipped with vinyl bumper strip and rubber feet.
  2. Capacity: 13-gal.
  3. Waste Receptacle: 22-gauge (0.8mm) stainless steel with satin finish. Equipped with vinyl bumper strip and rubber feet.
  4. Hooks are provided to attach optional, removable liner (not provided) to upper interior corners.
  5. Cover: 22-gauge (0.8mm) stainless steel with satin finish. Two spring-loaded, self-closing doors, which have an international graphic symbol to identify waste disposal, are secured with full-length, stainless steel piano-hinges.

6. Operation:
  - a. Entire cover is removable for easy servicing of receptacle. Vinyl bumper strip and rubber feet on waste receptacle protect wall and floor surfaces.

## 2.6 SOAP DISPENSER

- A. Product: Classic B-2111 (Vertical) by Bobrick.
  1. Type: Surface mount.
  2. Satin-finish stainless steel.
  3. Capacity: 40-fl-oz.
  4. Dispensing mechanism with stainless steel lever dispenses any free-flowing powdered soap. Agitator spring prevents soap build-up. Top opens with special key provided. Concealed wall fastening.
  5. Size: 4-3/4" W, 8-1/8" H.
  6. Wall to pushbutton: 3-1/2".

## 2.7 FRAMED MIRROR

- A. Product: B-290 by Bobrick.
  1. Material: 18-8 S, type 304, heavy gage, satin-finish stainless steel.
  2. One-piece roll formed frame is 3/4" x 3/4".
  3. Corners are heliarc welded, ground and polished smooth.
  4. Beveled edges.
  5. Mirror: No. 1 quality, 1•4" glass mirror electrolytically copper-plated.
  6. Warranted against silver spoilage for 15 years.
  7. Mirror edges protected with plastic filler strips to prevent chipping; back is protected by 3•16" thick, water-resistant, polyethylene padding.
  8. Galvanized steel back attached to frame with concealed screws.
  9. Mirror secured to concealed wall hanger with theft-resistant locking device.
  10. Sizes: As selected by Architect from standard sizes.

## 2.8 GRAB BAR

- A. Product: B-5837 by Bobrick.
  1. Type: Grab Bar for Toilet Compartment/Tub/Shower.
  2. Material: 18-8 S, type 304, 18-gage, stainless steel.
  3. Tubing: 1-1•4" and 1-1•2" diameters.
  4. Mounting: Concealed.
  5. Finish: Peened nonslip gripping surface.
  6. Bar passes through flange and is heliarc welded to form single structural unit.
  7. Size: 36" W x 54" D.
- B. Product: Wheelchair Toilet Compartment, B-5837 (36 x 54). L shape.
- C. Product: Tub/Shower/Toilet, B-58616 (32 x 28). L shape.

## 2.9 ROBE HOOK

- A. Product: Model B-76717 by Bobrick: Satin-finish stainless steel.
  - 1. Type: Single robe hook. Unique 2-piece mounting system. Concealed mounting bracket of 18-gauge stainless steel, welded inside each flange, mounts on 19-gauge stainless steel wall plate.
  - 2. Includes a stainless steel locking setscrew on bottom.

## 2.10 UNDERLAVATORY GUARDS

- A. Product: Handy-Shield by Plumberex Specialty Products, Inc. or equal.
  - 1. Description: Insulating pipe covering for supply and drain piping assemblies, that prevent direct contact with and burns from piping, and allow service access without removing coverings.
  - 2. Material and Finish: Antimicrobial, molded-plastic, white.

## 2.11 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

## SECTION 104400 - FIRE-PROTECTION SPECIALTIES

### 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 the following:
  - 1. Portable fire extinguishers.
  - 2. Fire-protection cabinets for the following:
    - a. Portable fire extinguishers.

#### 1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
  - 1. Fire Extinguishers: Include rating and classification.
  - 2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Samples for Initial Selection: For fire-protection cabinets with factory-applied color finishes.
- C. Samples for Verification: For each type of exposed factory-applied color finish required for fire-protection cabinets, prepared on Samples of size indicated below.
  - 1. Size: 6 by 6 inches square.
- D. Maintenance Data: For fire extinguishers and fire-protection cabinets to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
  - 1. Provide fire extinguishers approved, listed, and labeled by FMG.

## 1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10.
    - b. Faulty operation of valves or release levers.
  - 2. Warranty Period: 6 years.
- B. Installer Warranty: 1 year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Fire Extinguishers and Cabinets: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
  - 1. JL Industries, Inc. (Basis of Design)
  - 2. Larsen's Manufacturing Company.
  - 3. Potter Roemer; Div. of Smith Industries, Inc.
  - 4. Ansul.
  - 5. Or equal.

### 2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B.
- B. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick minimum.

### 2.3 PORTABLE FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet indicated.
  - 1. Valves: Manufacturer's standard.
  - 2. Handles and Levers: Manufacturer's standard.
  - 3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

4. Certification Tag: Provide fire extinguisher with valid certification test tag where fire extinguishers are fully charged and ready to be used.
- B. Dry Chemical Type: Cast steel tank, with pressure gage.
1. Class 2A-10B:C.
  2. Nominal Capacity: Provide largest capacity fire extinguisher that will fit in the cabinet, but 5 lbs. minimum.
  3. Finish: Baked enamel, red color.
  4. Use: General purpose.

## 2.4 FIRE-PROTECTION CABINET

- A. Product: Ambassador Series by J.L Industries.
1. Cabinet Type: Suitable for fire extinguisher.
  2. Construction:
    - a. Non-rated.
  3. Mounting: Recessed. Provide Semi-recessed where recessed can't be provided.
  4. Door Style: Vertical Duo swing door with tempered safety glass.
  5. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
    - a. Provide manufacturer's standard.
    - b. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
  6. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
  7. Door Lock: Cylinder lock, keyed alike to other cabinets.
  8. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
    - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
      - 1) Location: Applied to cabinet door.
      - 2) Application Process: Silk-screened.
      - 3) Orientation: Vertical.

## 2.5 FABRICATION

- A. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
  2. Miter and weld perimeter door frames.
- B. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.



## 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.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of 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.

## 2.7 STEEL FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.
- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
  - 1. Color: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where cabinets will be installed.
- B. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare recesses for recessed and semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated on Drawings.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
  - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire-protection cabinets.
  - 2. Provide inside latch and lock for break-glass panels.
  - 3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

END OF SECTION 104400

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

**DIVISION 16. ELECTRICAL**

**160000 – General** - Contractor shall review construction documents and provide labor and materials pertaining to the electrical system as required in construction documents and as specified herein, while complying with all applicable building codes, local utility requirements and building restrictions.

**160500 - Common Work Results For Electrical**

PART 1 - GENERAL

1.0 SUMMARY

- A. This section includes requirements for basic electrical materials and methods for the following items.
  - 1. Supporting devices for electrical components
  - 2. Electrical identification
  - 3. Electricity-metering components
  - 4. Concrete equipment bases
  - 5. Touch-up painting

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

- A. The latest edition of the following standards and codes, standard publications of professional organizations, and the local authorities having jurisdiction are the minimum requirements for this work.
  - 1. American National Standards Institute (ANSI)
  - 2. American Society for Testing and Materials (ASTM)
  - 3. Association of Edison Illuminating Companies (AEIC)
  - 4. Code of Federal Regulations (CFR)
  - 5. Insulated Cable Engineer's Association (ICEA)
  - 6. Institute of Electrical and Electronic Engineers (IEEE)
  - 7. National Electrical Manufacturer's Association (NEMA)
  - 8. National Fire Protection Association (NFPA)
  - 9. NFPA 70, The National Electrical Code (NEC)
  - 10. Underwriters' Laboratories, Inc. (UL)
  - 11. State, City, and Local Authorities

1.3 DEFINITIONS

- A. Instructions such as "Provide" shall mean the same as though the words "This Contractor shall" preceded each such instruction. "Provide" shall mean "Furnish and Install." Where the words "Accepted" or "Acceptable" are used, such "Accepted" or "Acceptable" action by the Engineer

## Window Rock Office Building and Site CONSTRUCTION DOCUMENTS

and/or Architect denotes that the work or equipment item is in conformance with the design concept of the project and, in general, complies with pertinent information given in the Contract Documents.

- B. EMT: Electrical metallic tubing
- C. ENT: Electrical nonmetallic tubing
- D. FMC: Flexible metal conduit
- E. IMC: Intermediate metal conduit
- F. LFMC: Liquidtight flexible metal conduit
- G. LFNC: Liquidtight flexible nonmetallic conduit
- H. RMC: Rigid metallic conduit
- I. RNC: Rigid nonmetallic conduit

### 1.4 SUBMITTALS

#### A. Product Data:

- 1. Hangers and supports
- 2. Electrical identification materials

- #### B. Coordination Drawings: Plans, sections, and elevations drawn to scale and coordinating installation of equipment, where required by the contract drawings or where site physical conditions limit installation capabilities.

### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70, the National Electrical Code.
- C. All equipment and materials will be new and unused and shall be in conformance with the current applicable industry standards. Workmanship and neat appearance shall be as important as electrical and mechanical operation. Defective or damaged materials shall be replaced or repaired prior to final acceptance in a manner meeting approval of Architect and/or Engineer and at no additional cost to the Owner.
- D. Specifications and drawings for fire alarm system, voice and data system, intercom system, access control system, photovoltaic system, and CCTV system are a performance specification only. Minimum requirements are depicted on the drawings. The contractor shall provide design, installation, testing, and commissioning for each performance specification.

### 1.6 SEQUENCING

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installation.
- B. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- D. Coordinate electrical service connections to components furnished by utility companies.

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components, prior to commencement of any work.
  2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- E. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 "Openings."
- F. No work shall be concealed until after inspection and approval by proper authorities. If work is concealed without inspection and approval, Contractor shall be responsible for all work required to expose and restore the concealed work in addition to all required modifications.
- G. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- H. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.0 SUPPORTING DEVICES FOR ELECTRICAL COMPONENTS

- A. Provide hangers and supports to support raceways, fixtures, cabinets, boxes, etc. as manufactured by B-Line, Unistrut, Binkley or Kindorf.
- B. Material: Cold-formed steel, with cortrosion-resistant coating acceptable to authorities having jurisdiction.
- C. Metal Items for Use Outdoors or in Damp Locations: Steel, hot-dip galvanized after fabrication.
- D. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch-diameter slotted holes at a maximum of 2 inches o.c., in webs.
1. Channel Thickness: Selected to suit structural loading.
  2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- E. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded Cclamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- G. Expansion Anchors: Carbon-steel wedge or sleeve type.
- H. Toggle Bolts: All-steel springhead type.
- I. Comply with seismic restraint requirements as defined in Section 16071.

2.1 ELECTRICAL IDENTIFICATION

- A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
1. As a minimum, identification means shall be installed on the following:
    - a. Panelboards, switchboards, switchgear, etc.
    - b. Transformers
    - c. Raceways and cables
    - d. Junction boxes
    - e. Disconnects

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

- f. Receptacles
  - g. Large or major electrical components (generators, transfer switches, fire alarm control panel, etc.)
- B. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.
- 1. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.
  - 2. Color: Black letters on orange background.
  - 3. Legend: Indicates voltage.
- C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick.
- D. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
- 1. Not less than 6 inches wide by 4 mils thick.
  - 2. Compounded for permanent direct-burial service.
  - 3. Embedded continuous metallic strip or core.
  - 4. Printed legend that indicates type of underground line.
- E. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
- F. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.
- G. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.
- H. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing, with colors, legend, and size appropriate to the application. 1/4-inch grommets in corners for mounting.
- I. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

## 2.2 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
- B. Meter Sockets: Comply with requirements of electrical power utility company.

## 2.3 CONCRETE EQUIPMENT BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division 3, "Cast-in-Place Concrete."
- B. Concrete: 3000-psi (20.7-MPa), 28-day compressive strength as specified in Division 3, "Cast-in-Place Concrete."

## 2.4 TOUCH-UP PAINT

16 05 00 - 4

## COMMON WORK RESULTS FOR ELECTRICAL

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

- A. Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.0 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Adhere to clearances required by the NEC, NFPA 70. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.1 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials
- C. Support Clamps for PVC Raceways: Click-type clamp system
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb. design load.
- F. Comply with seismic restraint requirements as defined in Section 16071.

3.2 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide Ubolts, clamps, attachments, seismic restraints, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps and appropriate seismic restraints.
- F. Install 1/4-inch-diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
  - 1. Wood: Fasten with wood screws or screw-type nails.
  - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
  - 3. New Concrete: Concrete inserts with machine screws and bolts.
  - 4. Existing Concrete: Expansion bolts.
  - 5. Threaded studs driven by a powder charge and provided with lock washers in existing concrete are not allowed unless approved by Architect.
  - 6. Steel: Welded threaded studs or spring-tension clamps on steel. Field welding shall comply with AWS D1.1.
  - 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
  - 8. Light Steel: Sheet-metal screws.
  - 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof test load.

### 3.3 IDENTIFICATION MATERIALS AND DEVICES

- A. All components of electrical system shall be neatly and accurately labeled to facilitate ready identification and service. Temporary type of markings, which are visible on equipment, will not be permitted. Repaint trims, housing, etc. where such markings cannot be readily removed. Defaced finish must be refinished. Provide labels as follows (or indicated elsewhere):
  - 1. Provide engraved composition nameplates on each branch circuit panel board, etc. Lettering shall be 1/2 inch minimum height for panel boards. Apply labeling for panel boards on outside of each panel board door and include voltage and phase.
  - 2. Provide neatly-typed directory cards for all branch circuit panel board directories.
  - 3. Provide engraved composition nameplates having 3/8 inch minimum height, white letters engraved in a black face for each switch or circuit breaker in switchboards and subdistribution boards. Provide labeling of matching style designating all units as designated on drawings. Secure all lamenoid nameplates with rivets or screws. Adhesives will not be allowed.
  - 4. Use of Dymolabels for panels and circuit number identification on all receptacle covers and disconnect switches in mechanical and equipment rooms is forbidden.
  - 5. Provide engraved composition nameplates on all time clocks, starters, etc. Lettering shall be 3/8 inches minimum height for equipment. Labeling for equipment shall be in accordance with designations given on the associated drawings.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and



Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

standards. Install at locations for most convenient viewing without interference with operation and maintenance of equipment. Use consistent designations throughout Project.

1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
  2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
  3. Colors:
    - a. Fire Alarm System: Red
    - b. Security System: Blue and yellow
    - c. Telecommunication System: Green and yellow
- C. Tag and label each feeder conductor (having an operating voltage of 600 volts or less) in pull boxes with an engraved, non-metallic tag, having 3/16-inch minimum height letters. Tag shall be a minimum of one inch diameter or square. State circuit number and phase (A, B, C).
- D. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.
- E. Color-code 208/120V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
1. Phase A: Black
  2. Phase B: Red
  3. Phase C: Blue
  4. Neutral: White
  5. Ground: Green
- F. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
- G. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- H. All electrical distribution equipment shall contain an arc flash label per NEC. The arc flash labels shall comply with attachment 1, which is included at the end of this specification section.

### 3.4 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

### 3.5 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7.

### 3.6 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated.

### 3.7 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
  - 1. Supporting devices for electrical components
  - 2. Electrical identification
  - 3. Electricity-metering components
  - 4. Concrete equipment bases
  - 5. Touch-up painting

### 3.8 REFINISHING AND TOUCH-UP PAINTING

- A. Refinish and touch-up paint as required. Paint materials and application requirements are specified in Division 9.

### 3.9 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 220500

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

**160600 – Grounding And Bonding**

PART 1 - GENERAL

1.0 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

- A. Product Data: For the following:
  - 1. Ground rods
  - 2. Chemical rods
  - 3. Ground enhancement material
  - 4. Lightning protection system ground components
- B. Provide written 1 year (minimum) product warranty against defects in materials and workmanship.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- D. Field Test Reports: Submit written test reports to include the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and Corrective action taken to achieve test results that comply with requirements.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Comply with UL 467.
- B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

- A. Manufacturers/Suppliers: Subject to compliance with requirements, provide products by one of the following:

16 06 00 - 1

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

1. Grounding Conductors, Cables, Connectors, and Rods:
  - a. Apache Grounding/Erico Inc.
  - b. Boggs, Inc.
  - c. Chance/Hubbell.
  - d. Copperweld Corp.
  - e. Dossert Corp.
  - f. Erico Inc.; Electrical Products Group
  - g. Framatome Connectors/Burndy Electrical
  - h. Galvan Industries, Inc.
  - i. Harger Lightning Protection, Inc.
  - j. Hastings Fiber Glass Products, Inc.
  - k. Heary Brothers Lightning Protection Co.
  - l. Ideal Industries, Inc.
  - m. ILSCO
  - n. Kearney/Cooper Power Systems
  - o. Korns: C. C. Korns Co.; Division of Robroy Industries
  - p. Lightning Master Corp.
  - q. Lyncole XIT Grounding
  - r. O-Z/Gedney Co.; a business of the EGS Electrical Group
  - s. Raco, Inc.; Division of Hubbell
  - t. Robbins Lightning, Inc.
  - u. Salisbury: W. H. Salisbury & Co.
  - v. Sankosha Corp.
  - w. Superior Grounding Systems, Inc.
  - x. Thomas & Betts, Electrical
  - y. VFC Inc.

## 2.1 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 16, Section 16120 "Low-Voltage Electrical Power Conductors and Cables."
- B. Material: copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- F. Bare Copper Conductors: Comply with the following:
  1. Solid Conductors: ASTM B 3.
  2. Assembly of Stranded Conductors: ASTM B 8.
  3. Tinned Conductors: ASTM B 33.
- G. Copper Bonding Conductors:
  1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
  2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
  3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with

16 06 00 - 2

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

## 2.2 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

## 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Sectional type; copper-clad steel.
  - 1. Size (Diameter, length): 3/4 inch by 120 inches
- B. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.
- C. Test Wells: Provide handholes as specified in other Division 26 Division 16 Electrical sections, as well as other specification Divisions.
- D. Groundbed electrode: The groundbed electrode is essentially a fat counterpoise consisting of a grounding conductor laid in a trench and encased in conductive cement (Erico GEM or Sankosha San-Earth).

## 2.4 GROUNDING BUS

- A. Provide bare, annealed copper bars with insulators.
  - 1. Service grounding bus shall wrap the perimeter of the rooms housing service equipment.
  - 2. Electrical room grounding bus shall be a minimum of 24 inches in length.
  - 3. Telecommunication equipment room grounding bus shall be a minimum of 12 inches in length.

## PART 3 - EXECUTION

### 3.0 APPLICATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
- F. Grounding Bus: Install in electrical and telecommunication equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
  - 2. At doors, route the bus up to the top of the doorframe, across the top of the doorway, and

16 06 00 - 3

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

down to the specified height above the floor.

- G. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.
- H. Separately Derived Systems: Electrical equipment creating separately derived distribution systems, such as dry-type transformers, shall utilize the equipment ground bars in the equipment enclosure for both secondary equipment ground and secondary neutral ground with separate grounding conductor extended to an approved ground electrode.

### 3.1 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and circuits. This grounding conductor shall be in addition to the ground path provided by the continuously grounded metallic raceway system that encloses the phase and neutral conductors. Where there are parallel feeders installed in more than one raceway, each raceway shall have a green insulated equipment ground conductor.
- C. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- D. Air Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 volts and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- E. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- F. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, telecommunication room, and central equipment location.
  - 1. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
  - 2. Central Equipment Locations and Telecommunication Equipment Rooms: Terminate grounding conductor on a grounding bus with insulated spacers.
- G. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.
- H. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

### 3.2 COUNTERPOISE (GROUND RING)

- A. Ground the steel framework of the building with a driven ground rod at the base of every Corner column and at intermediate exterior columns at distances not more than 60 feet apart. Provide a grounding conductor (counterpoise), electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Use tinned-copper conductor not less than No. 2/0 AWG for counterpoise and for tap to building steel. Bury counterpoise not less than

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

24 inches below grade and 5 feet from building foundation. Provide ground enhancement cement and follow the manufacturer's instructions for trench depth, encasement requirements, etc.

### 3.3 INSTALLATION

- A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
  - 1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
  - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Grounding electrode conductors and bonding jumpers shall be installed in raceway.
- C. Service Equipment: Install insulated equipment grounding conductor from the grounding bus in the switchgear to the wall mounted grounding bus. Terminate grounding conductor on grounding bus with insulated spacers.
- D. Underground Grounding Conductors: Use bare copper wire. Bury at least 24 inches below grade.
- E. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- F. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- G. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- H. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- I. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor. Fill with 1-inch-maximum-size crushed stone or gravel.

### 3.4 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact. Clean surfaces thoroughly before applying ground lugs or clamps. If surface is coated, the coating must be removed

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

- down to the bare metal. After the coating has been removed, apply a nonCorrosive approved compound to clean surface and install lugs or clamps. Where galvanizing is removed from metal, it shall be painted or touched up with "Galvanox," or equal.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
  5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

### 3.5 OVERHEAD-LINE GROUNDING

- A. Comply with IEEE C2 requirements. Use two or more parallel ground rods if a single ground rod electrode resistance to ground exceeds 25 ohms.
- B. Drive ground rods to a depth of 12 inches below finished grade in undisturbed earth.
- C. Ground Rod Connections: Use clamp-type connectors listed for the purpose for underground connections and connections to rods.
- D. Lightning Arresters: Separate arrester grounds from other grounding conductors.
- E. Secondary Neutral and Tank of Transformer: Interconnect and connect to grounding conductor.
- F. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.
- G. Comply with local utility requirements.

### 3.6 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad.



Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

- B. Comply with local utility requirements.

### 3.7 FIELD QUALITY CONTROL

- A. Tests: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
  - a. Equipment Rated 500 kVA and Less: 10 ohms.
  - b. Equipment Rated 500 to 1000 kVA: 5 ohms.
  - c. Equipment Rated More Than 1000 kVA: 3 ohms.
  - d. Pad mount transformer: 5 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
5. Report: Prepare test reports, certified by the testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

### 3.8 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 32 "Exterior Improvements." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 160600

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

**161000 – Electrical** - From electrical meter box, install above or below ground wiring to building. Raceways to be buried shall be PVC #2 Plastic Electrical conduit. Where permitted by code, non-metallic sheathed cable may be used. Type THW or THWN 600 volt insulation conductors shall be used; minimum wire size shall be #12. Aluminum wire shall not be permitted. Wiring shall connect into metal recessed electrical panel, as shown on construction documents. Electrical service shall be rated at 320 amps. Wiring from the outside meter box shall be SE cable.

**161200 – Conductors and Cables** - Provide and install necessary circuits and breakers for appliances as stated in manufacturer's recommendations per applicable building code. Wire sizes and types shall be as specified in the construction documents.

**161300 – Raceway and Boxes** – Flexible or rigid conduits, couplings, supports and nonmetallic ducts. Install conduit concealed in all areas, excluding mechanical and electrical rooms/areas, connections to motors and connections to surface cabinets. Coordinate installation of conduit in masonry work. Unless indicated otherwise, do not install conduit larger than 2 1/2 inches in concrete slabs. Provide a minimum concrete cover around conduits of 2 inches. Install conduit free from dents and bruises. Plug ends to prevent entry of dirt and moisture. Minimize crossovers. Provide flashing and pitch pockets, making watertight joints where conduits pass through roof or waterproofing membranes. Route all exposed conduits parallel or perpendicular to building lines. All fittings shall be UL approved.

- A. Fasten raceways securely in place. Firmly fasten within 3 feet of each outlet, junction box, cabinet or fitting. Support every 10 feet.

**161400 – Wiring Devices** - Install white receptacles, switches and cover plates as per construction documents and finish schedules. For exterior receptacles install gray cover plates. When there are two or more switches or receptacles located together, gang with one common faceplate. If they cannot be ganged, install with a minimum distance between units. Install all receptacles at 18" on center (OC) above finished floor (AFF), unless otherwise noted. At counters, locate receptacles at 44" on center (OC), above finished floor (AFF). Install switches at 48" on center (OC) above finished floor (AFF). Locate light switch cover plates 6" from frame of door or corner of wall.

- A. Switches shall be: Toggle.

**162890 – Surge Protection Devices**

PART 1 - GENERAL

1.0 SUMMARY

- A. Section Includes: This specification includes requirements for a high energy surge protective devices (SPDs) used to protect AC electrical distribution from the effects of lightning, utility switching events, and voltage impulses generated internally within a facility.
- B. Design and Performance Requirements:
  - 1. The SPDs covered under this section include surge protection devices suitable for use as Type 2 devices as defined by UL 1449, Third Edition.
  - 2. System shall be tested to meet ANSI/IEEE C62.41.1-2008, and tested per ANSI/IEEE C62.45-2002. The system shall be UL 1449 listed as a complete system under the Third

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

- Edition standard for SPDs. Systems not UL 1449, Third Edition listed are not acceptable.
3. The system shall be tested by a Nationally Recognized Testing Laboratory (NRTL). Systems not tested by an NRTL are not acceptable.
  4. The surge suppression, bonding, and grounding required in this specification for the protection of electrical and electronic systems shall effectively protect the systems to which it is applied against transient surges caused by lightning and other causes throughout the useful life of the system.
  5. The connection of the required protective devices, bonds, and grounds shall neither impair nor interrupt the normal operation of any electrical or electronic system.

C. SPD protection cascade levels indicated on the drawings:

1. SPD protection cascade levels are indicated on the drawings with the required minimum SPD Surge Rating in thousands of Amps (kA). If there is no SPD Surge Rating on the plans, the minimum SPD Surge Rating shall be as prescribed in these specifications.
2. Refer to paragraphs below for the parameters prescribing the identified cascade level of SPD.

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

- A. All SPD devices will be designed, tested, manufactured, listed, and installed in accordance with The applicable publications, resources, and standards shown below:
1. ANSI/IEEE C62.41.1-2008, Guide On The Surge Environment In Low-Voltage (1000 V And Less) AC Power Circuits
  2. ANSI/IEEE C62.45-2002, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits
  3. ANSI/IEEE C84.1, 2006, Standard for Electric Power Systems and Equipment - Voltage Ratings (60 Hertz)
  4. ANSI/IEEE Standard 141-1993 (R1999), Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book)
  5. FIPS Pub 94, Federal Information Processing Standards Publication - Guideline on Electrical Power for ADP Installations
  6. IEEE Standard 142-2007 IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book)
  7. IEEE Standard 1100-1999, IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (IEEE Emerald Book).
  8. Information Technology Industry Council (ITI) (formerly CBEMA)
  9. ISO 9001: 2008, Quality Management Systems - Model for Quality Assurance in Design, Development, Production, Installation, and Servicing
  10. MIL Standard 220B, 24 January 2000, Test Method Standard - Method of Insertion Loss Measurement
  11. National Fire Protection Association - NFPA-70 (National Electrical Code)
  12. Underwriters Laboratories UL 1283 Electromagnetic Interference Filters, 30 June 1998, Revision 2.
  13. Underwriters Laboratories UL 1449 Standard for Surge Protective Devices, Third Edition

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

(2009 Revision effective 9/29/2009).

- B. Electrical work shall meet the requirements of national, state, and local codes that govern the project. It shall be the Contractor's responsibility to be aware of and abide by the governing codes.

### 1.3 WIND AND SEISMIC CRITERIA

- A. All system components must comply with the wind and seismic requirements of Section 16773 "Wind, Seismic, and Vibration Controls for Electrical Work". These include requirements for anchorage, internal, and attached/imbedded components. Included are the minimum 2006 IBC requirements plus additional criteria for this project.
- B. Seismic Performance:
  - 1. Electrical equipment, integrally mounted and separately mounted accessories and components with a component importance factor of 1.5 shall withstand the effects of earthquake motions determined according to ASCE 7 and remain operational.
  - 2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

### 1.4 SUBMITTALS

- A. Product Data:
  - 1. Complete product data detailing compliance, or exception in a paragraph by paragraph listing, to all provisions of this specification.
  - 2. Copies of documentation stating that the Surge Protection Device is listed from an NRTL (UL, ETL, etc) and are tested and listed to UL 1449.
  - 3. Indicate the type of internal or external fusing that is incorporated in the SPD system and what impact the fusing has on the performance of the device with respect to surge capacity and clamping levels.
  - 4. Copies of test reports from n NRTL, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on a per mode basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.
  - 5. Installation, operation and maintenance manuals: Provide one copy of the installation, start-up, operation and maintenance manuals for each type unit supplied.
- B. Shop Drawings: Provide electrical and mechanical drawings that include detail on unit dimensions, weights, wire size, field connections and mounting provisions. Installation instructions shall clearly state whether the system requires an external over current device to maintain the system's UL 1449 listing.
- C. Manufacturer's qualifications
- D. Warranty and warranty statement
- E. Lead length equivalent clamping voltages

### 1.5 QUALITY ASSURANCE

- A. Qualifications:

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

1. Each complete suppression unit shall be supplied by a manufacturer whose Quality System has been certified as compliant with ISO 9001:2008 or has a UL-Certified Test Laboratory.
2. Manufacturers shall provide proof that they have been regularly engaged in the design, manufacturing and testing of SPD equipment for not less than 10 years.

B. Regulatory Requirements:

1. Each complete suppression unit shall be Underwriters Laboratories (UL) 1449, Third Edition listed.
2. Units shall bear the Voltage Protection Rating (VPR) issued by UL for all protected modes.
3. The complete SPD assembly shall have a UL assigned short circuit current rating (SCCR) of 200 kA. The SPD shall be marked with a short circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that short circuit current rating. If the short circuit rating of the device is less than the available fault current, then surge suppression-type fuses with fuseholder/disconnect must be included with the submittal.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer shall provide a product warranty for a period of not less than 10 years. Provide a copy of warranty statement clearly establishing the terms and conditions to the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading: Deliver all materials to the Work site in original, new, and unopened containers bearing the manufacturer's name and label.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

- A. The listing of specific manufacturers below does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.
  1. Advanced Protection Technologies, Inc. (APT)
  2. GE Power Quality
  3. Innovative Technologies (Eaton)
  4. LEA International
  5. Liebert Corporation
  6. Thomas & Betts Power Solutions
    - a. Joslyn
    - b. Current Technology

2.1 MANUFACTURED UNITS

- A. Equipment design shall provide a multi-stage parallel protector with voltage ratings as specified

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

below. The equipment surge current rating minimum surge current, clamping voltage, and maximum continuous operating voltage, shall be based on an 8 x 20 microsecond waveform per ANSI/IEEE C62.41 Category C3. Declared Maximum Continuous Operating Voltage (MCOV) shall be at least 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449 Third Edition, section 38.

- B. Minimum nominal discharge surge current: 20kA.
- C. Unit shall have not more than 10% deterioration or degradation of the UL1449 Third Edition Voltage Protective Rating (VPR) due to repeated surges.
- D. Unless indicated otherwise, the suppression system shall incorporate a hybrid design consisting of any of the following: selenium cells, silicon avalanche diodes, MOV arrays and filtering capacitors. These components shall optimally share surge currents to ensure maximum performance and long-term reliability. The system shall not utilize gas tubes, spark gaps, or other components that might short leading to power interruption.
- E. Each protection array shall be capable of withstanding the indicated quantity of sequential 10,000-Amp ANSI/IEEE C62.41 Category C3 impulses without degradation or failure. Each system must have indicator lights to report the status of each surge suppression mode (L-N, LG, N-G, etc.). Indication of AC line status only is not acceptable. The failure of a single MOV shall result in annunciation via an indicating light. Systems that require external testing equipment or tests to insure proper surge protection operation are expressly excluded. Unit shall have a monitoring option available to be able to test and determine the percentage of protection available at all times.
- F. The SPD shall be fused per UL 1449 Third Edition with fuses capable of allowing the suppressor's maximum rated transient current to pass through suppressor without fuse operation. Each phase shall be individually fused with 200,000 AIC rated class J fuses for maximum fault current protection. The complete SPD assembly shall have a UL assigned short circuit current rating (SCCR) of 200 kA All overcurrent protection circuits shall be monitored and provide indication of suppression operability or failure.
- G. Protection modes: Protection modes are identified in the tables below and as appropriate for the application. Refer to the one line diagrams for voltage ratings, 3-wire and 4-wire systems, system ampacities and SPD Surge Rating. The SPD shall provide bi-directional, positive, and negative impulse protection for:
  - 1. Line to Line (L-L)
  - 2. Line to Neutral (L-N)
  - 3. Line to Ground (L-G)(WYE or Delta)
  - 4. Neutral to Ground (N-G)
- H. SPDs shall have peak clamping and let-through voltages as prescribed in paragraphs below. Testing shall be done in accordance with ANSI/IEEE C62.41, on the complete suppression unit with lead length comparable to that needed to connect the SPD to the equipment to be protected. Lead length is defined as the length between the SPD device enclosure exterior to the connection point of the equipment to be protected. The lead length parameter must be specified on test documentation and shall not be less than 36-inches. For SPD devices manufactured without fixed leads, or lengths less than 36-inches, furnish calculations and supporting documentation for equivalent clamping voltages at the required lead length.
- I. No appreciable magnetic fields shall be generated by the SPD. All units must be capable of use directly in computer rooms in any location without danger to disk units, disk packs, or tapes.
- J. Enclosure: NEMA 1 where installed indoors, NEMA4 where installed outdoors.
- K. Environmental Requirements

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

1. Storage Temperature: -55 to +85°C (-67 to +185°F)
  2. Operating Temperature: -40 to +60°C (-40 to +140°F)
  3. Relative Humidity: 0% to 95% (non-condensing)
  4. Audible Noise: less than 45dB at 1.5m (5 feet)
  5. Operating Altitude: 0 to 18,000 feet above sea level
- L. The SPD system shall include noise filtering provide minimum 33 dB at 100 MHz as measured by the MIL Standard 220B Insertion Loss Test method.
- M. Each fuse shall be individually sealed in a manner that eliminates the potential for cross arcing.
- N. Each unit shall provide the following features:
1. Phase Indicator lights,
  2. Form C dry alarm contacts,240 Volts, 5A
  3. Field testable while installed.

### 2.3 SPD FOR ELECTRICAL SERVICE ENTRANCE

- A. The SPD suppression system shall incorporate a hybrid design consisting of any of the following: selenium cells, silicon avalanche diodes, MOV arrays and filtering capacitors.
- B. Suppressors shall have the following minimum surge current ratings per mode, and not less than the switchboard/panelboard AIC rating.
- 400 – 800-Amp Distribution Panel: 100,000 Amps/mode

### 2.4 SPD FOR BRANCH PANELBOARDS

- A. The SPD suppression system shall incorporate a hybrid design consisting of any of the following: selenium cells, silicon avalanche diodes, MOV arrays and filtering capacitors.
- B. Suppressors shall have the following minimum surge current ratings per mode, and not less than the switchboard/panelboard AIC rating.
- 400 – 800-Amp Distribution Panel: 100,000 Amps/mode  
100 – 400-Amp Panelboard: 80,000 Amps/mode

## PART 3 - EXECUTION

### 3.0 EXAMINATION

- A. Site Verification of Conditions: Examine the areas and conditions under which the transient voltage surge suppressors are to be installed and correct conditions detrimental to the completion of work.
- B. Verify the proper application of the SPD (ie. voltage, phases, etc.) and coordinate with upstream and downstream transient suppression. Assure that all neutral conductors are bonded to the system ground at the service entrance or the serving transformer prior to installation of the associated SPD.

### 3.1 INSTALLATION/APPLICATION

- A. Special techniques: Install the SPDs as indicated in the manufacturer's installation instructions, in accordance with the applicable portions of NEC, and in accordance with recognized industry practices to ensure that the product complies with requirements. NEC, State, and local codes

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

will prevail.

- B. Suppressors shall be installed without unnecessary bends and as close as practical to the equipment, switchgear, switchboard, or panelboard being protected in such a way to minimize connecting lead length. Suppressor leads shall not extend beyond either the manufacturer's recommended length or three feet, whichever is less, without approval. Unless indicated otherwise, install the circuit breaker (OCP) feeding the SPD in the top position of the switchboard or panelboard; mount the SPD above the section housing the circuit breaker. Use stranded conductors to connect between the OCP and the SPD. Bundle and twist all conductors including neutral and ground between the supply terminals and SPD two-twists per 12-inches.
- C. Main service entrance suppressor at wireway gutter shall be connected to the service by means of a fused disconnect switch. All interconnection wiring to source protected gear shall be per the manufacturer's recommendations; minimum sizes shall be #6 AWG stranded 80kA SPDs, and minimum #2 AWG for 200kA, 150kA and 100kA SPDs. Terminals shall be provided for all necessary power and ground connections.
- D. Interface with Other Work: Coordinate with other electrical work as necessary to interface installation of the surge suppression systems with other work on the site. This includes verification of ground conductor termination capabilities, coordination of SPD supply breaker/fuse if used, and verification of SPD location and space requirements on the switchboard, panelboard, etc.

### 3.2 FIELD QUALITY CONTROL

- A. Site Tests, Inspection: Perform field testing on each device in accordance with manufacturer's recommended procedures. Inspect each SPD installation and provide the Owner with a letter stating equipment and installation meets intent of Contract Documents, and manufacturer's warranties and guarantees are in effect.
- B. Manufacturers' Field Services: The manufacturer's representative shall be available for consultation to provide all necessary instructions for proper installation of the equipment.

### 3.3 TRAINING

- A. Provide up to two hours training of the theory, operation, maintenance, and troubleshooting of the SPD system.

END OF SECTION 162890



Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

**164100 – Enclosed Switches And Breakers**

PART 1 - GENERAL

1.0 SUMMARY

- A. Section Includes: This section includes requirements for individually mounted and enclosed fused and non-fused disconnect switches, fuses, and circuit breakers for disconnecting and protecting services, feeders, branch circuits, and utilization equipment.

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

- A. The latest edition of the following standards and codes, standard publications of professional organizations, and the local authorities having jurisdiction are the minimum requirements for this work.
  - 1. American National Standards Institute (ANSI)
  - 2. Institute of Electrical and Electronic Engineers (IEEE)
  - 3. National Electrical Manufacturer's Association (NEMA)
  - 4. National Fire Protection Association (NFPA)
  - 5. NFPA 70, the National Electrical Code (NEC)
  - 6. Underwriters Laboratories, Inc. (UL)
  - 7. State, city, and local authorities

1.3 DEFINITIONS

- A. FDS: Fused Disconnect Switch
- B. NFDS: Non-fused Disconnect Switch
- C. RMS: Root Mean Square
- D. SPDT: Single-pole Double-throw

1.4 SUBMITTALS

- A. General:
  - 1. Submit each item in this Article according to the Conditions of the Contract and Division 1 Specifications.
  - 2. All exceptions to this specification shall be given in written format referencing the section and paragraph and stating the proposed alternative to the requirement.
  - 3. The information continued in the submittal shall be complete in every respect, as partial submittals shall be cause for rejection.
- B. Product data for disconnect switches, circuit breakers, and accessories specified in this section as follows:

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

1. Descriptive data and ratings for voltage, continuous current, maximum horsepower, and short circuit rating
2. Dimensional plans, elevations, sections, and details
3. NEMA enclosure type and size
4. Cable terminal size, number, and material
5. Unit wiring diagrams depicting local and remote devices
6. Accessories device descriptive bulletins and product data sheets (i.e. shunt trip coil, undervoltage release, ground fault, auxiliary contacts, key interlocks, etc.)

### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70, the National Electrical Code.
- C. All equipment and materials will be new and unused and shall conform with the current applicable industry standards. Workmanship and neat appearance shall be as important as electrical and mechanical operation. Defective or damaged materials shall be replaced or repaired prior to final acceptance in a manner meeting approval of Architect and/or Engineer and at no additional cost to the Owner.

## PART 2 - PRODUCTS

### 2.0 MANUFACTURERS

- A. Disconnect Switches and Circuit Breakers: Acceptable manufacturers are listed below. All disconnect and circuit breakers shall be of the same manufacturer.
  1. Cutler-Hammer
  2. General Electric Company
  3. Square D Company
- B. Fuses: Acceptable manufacturers are listed below. All fuses shall be of the same manufacturer.
  1. Cooper Bussman, Inc.
  2. Ferraz Shawmut, Inc.
  3. Tracor, Inc.; Littelfuse, Inc. Subsidiary

### 2.1 DISCONNECT SWITCHES

- A. Enclosed fusible and non-fusible switches, 1200-amp and smaller, NEMA KS1, heavy duty type with lockable handle, 600-volts, horsepower rated for motors as required. Number of poles and ampacity as noted or required by Code. Short-circuit rating shall be sufficient to withstand the available fault current or let-through current before the fuse melts without damage or change in rating.
- B. Fusible switches 30- through 600-amperes shall be furnished with rejection class "R" or "J" type fuse clips and 800 through 1200 amperes shall be furnished with class "L" type fuse clips.
- C. Switches shall incorporate a safety cover interlock to prevent opening the cover with the switch in the "ON" position or prevent placing the switch in the "ON" position with the cover open. Provide a "defeater" for authorized personnel.

16 41 00 - 2

## ENCLOSED SWITCHES AND BREAKERS

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

- D. Handles shall have provisions for padlocking and shall clearly indicate the ON and OFF positions. Front cover doors shall be padlockable in the closed position.

## 2.2 FUSES

- A. Fuses shall be Class K-1 and K-5 of rejection type for 600 amperes and below and Class L for over 600 amperes. Fuse voltage class shall be either 250 volt or 600 volt and shall be applied according to circuit voltage.
- B. Coordinate the low-voltage fuses required for the project to provide basic selective protection and properly coordinate with the other associated protective equipment.

## 2.3 CIRCUIT BREAKERS

### A. General:

1. Provide 600-volt enclosed molded case circuit breaker per NEMA AB1 with lockable handle with frame size, trip rating, number of poles, and interrupting rating to meet available fault current. Application listing shall be appropriate for switching fluorescent lighting loads or heating, air conditioning, and refrigerating equipment.
2. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quickbreaker over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
3. Thermal-magnetic Circuit Breakers: Frame sizes 400 amp and smaller shall have inverse timecurrent element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 amp and larger.
4. Adjustable Instantaneous-trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
5. Electronic Trip Unit Circuit Breakers: Frame sizes 600 amp and larger shall have RMS sensing; field-replaceable rating plug; with the following field-adjustable settings as noted on the drawings by L, S, I, and G.
  - a. Instantaneous trip
  - b. Long- and short-pickup levels
  - c. Long- and short-time adjustments
  - d. Ground-fault pickup level, time delay, and  $I_{2t}$  response
6. Current-limiting Circuit Breakers: Frame sizes 400 amp and smaller; let-through ratings less than NEMA FU 1, RK-5.
7. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity for personal protection and 30 mA trip sensitivity for equipment protection.
8. Molded-case Switch: Molded-case circuit breaker without trip units.

### B. Circuit-breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style suitable for number, size, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

3. Ground-fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Shunt Trip: 120-volt trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

#### 2.4 ENCLOSURE

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
  1. Outdoor Locations: NEMA 250, Type 3R
  2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4

### PART 3 - EXECUTION

#### 3.0 INSTALLATION

- A. Comply with mounting and anchoring requirements specified in Division 16, Section 16733, "Vibration and Seismic Controls for Electrical Systems."
- B. Install devices in general area of equipment and accessible to maintenance personnel according to manufacturer's written instructions. Secure devices firmly to supporting structure with approved fasteners in a level and plumb manner. Verify voltage and amperage size and enclosure type of devices for each installation. Where practical, devices shall be mounted such that the top of switch is a maximum of 6'-0" above finished floor or surface.
- C. Connect devices to wiring system and to ground as indicated and instructed by manufacturer. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse. Install labels indicating fuse replacement information on inside door of each fused switch.
- E. Identify each device according to requirements in other sections of these specifications.

#### 3.1 OVERCURRENT PROTECTIVE DEVICES

- A. Install fuses where required as a protective device in conformance with equipment manufacturer's specified requirements and in accordance with the requirements of this section.

#### 3.2 EQUIPMENT CONNECTIONS

- A. Provide all final power connections for mechanical equipment. All equipment items will be furnished and set by others. Confirm with suppliers all rough-in data, e.g., electrical characteristics, dimensions, locations, type of connection, etc., prior to installation.

END OF SECTION 164100

**164400 – Panelboards** - Panelboards shall be Square “D” (or approved equal). Provide typewritten directory of circuits mounted in box. Use dead front panelboards with one-piece cabinets constructed from code gauge steel, finished with rust inhibiting primer and baked enamel finish and manufacturer’s standard color. Use factory assembled panelboards with amp rating units indicated. Provide spare units and blank spaces as indicated.

**165000 – Light Fixtures** - Provide necessary circuits and wiring for light fixtures as listed below. All lighting shall be switched as noted on construction documents. For exact locations of fixtures, see construction documents and finish schedules. Fixture allowances are listed in Contract Documents.

### **167730 - Vibration And Seismic Requirements For Electrical Systems**

#### PART 1 - GENERAL

##### 1.0 SUMMARY

- A. This section includes performance based design requirements for Seismic Restraints and Equipment Operability Requirements and Vibration Isolation for electrical systems.
- B. Contractor is to engage the services of a Professional Engineer licensed in the state of Arizona to design necessary seismic restraints and vibration isolators as necessary to comply with all applicable National and Local Codes and requirements of Authority Having Jurisdiction.
- C. This Section includes requirements for the following materials:
  - 1. Isolation pads
  - 2. Spring isolators
  - 3. Restrained spring isolators
  - 4. Channel support systems
  - 5. Restraint cables
  - 6. Hanger rod stiffeners
  - 7. Anchorage bushings and washers
- D. Related Sections include the following:
  - 1. Division 16 Section 16050 "Common Work Results for Electrical" for commonly used electrical supports and installation requirements.

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 DEFINITIONS

- A. IBC: International Building Code, latest edition.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.
- D. ASCE 07 American Society of Civil Engineers

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

1.3 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: Class D for the Admin Building and Warehouse.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: Refer to Structural.
  - a. Component Importance Factor: 1.5
  - b. Component Response Modification Factor: Design Professional to obtain value from ASCE-07 Table 13.6-1 based on equipment/system to be braced.
  - c. Component Amplification Factor: Design Professional to obtain value from ASCE-07 Table 13.6-1 based on equipment/system to be braced.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): Refer to Structural-0.24G
4. Design Spectral Response Acceleration at 1.0-Second Period: Refer to Structural - 0.06G.

1.4 SUBMITTALS

A. Product Data:

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
  - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
  - b. Annotate to indicate application of each product submitted and compliance with requirements.
2. Electrical equipment manufacturer's special certification requirements per ASCE-07 Section 13.2.2 for structures with a Seismic Design Category C through F containing electrical equipment that must remain operable following the design earthquake. Equipment manufacturer's certification may be submitted with Product Data for the applicable equipment under the appropriate Division 16 specification sections
  - a. Provide manufacturer's certification of operability approved and stamped by a registered professional engineer.
  - b. Indicate whether certification is based on shake table testing or experience data.
3. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
4. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads. Bumper restraints or snubbers shall have nominal clearance (air gap) between equipment frame and restraint less than 0.25 inch.

- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer registered in the state of project responsible for their

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select snubbers and seismic restraints.
    - a. Coordinate design calculations with wind and snow-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 16 Sections for equipment mounted outdoors.
  2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
  3. Field-fabricated supports.
  4. Seismic-Restraint Details:
    - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile, compressive and shear loads.
    - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
    - d. Design restraints to comply with critical equipment manufacturers requirements and to achieve system operability as defined by manufacturer's certification design limits per Section 1.5 subpart A.2.
- C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Qualification Data: For testing agency.
- F. Field quality-control test reports.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combined shear, compressive and tensile loads) to support

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

seismic-restraint designs must be signed and sealed by a qualified professional engineer in project state.

- E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.0 VIBRATION ISOLATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide one of the following manufacturer's or a comparable product by one of the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation
4. Isolation Technology, Inc.
5. Kinetics Noise Control
6. Mason Industries
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation
9. Vibration Mountings & Controls, Inc.

- B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel base plates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

- C. Spring Isolators [Insert drawing designation]: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80% of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50% of the required deflection at rated load.
3. Lateral Stiffness: More than 80% of rated vertical stiffness.
4. Overload Capacity: Support 200% of rated load, fully compressed, without deformation or failure.
5. Base plates: Factory drilled for bolting to structure and bonded to 1/4-inch-(6-mm-)thick, rubber isolator pad attached to base plate underside. Base plates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

- D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled base plate bonded to 1/4-inch-(6-mm-)thick, neoprene or rubber isolator pad attached to base plate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction. Air gaps shall be 0.25 inch or less.



Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

3. Outside Spring Diameter: Not less than 80% of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50% of the required deflection at rated load.
5. Lateral Stiffness: More than 80% of rated vertical stiffness.
6. Overload Capacity: Support 200% of rated load, fully compressed, without deformation or failure.

## 2.1 SEISMIC-RESTRAINT DEVICES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide one of the following manufacturer's or a comparable product by one of the following:
  1. Amber/Booth Company, Inc.
  2. California Dynamics Corporation
  3. Cooper B-Line, Inc.; a division of Cooper Industries
  4. Hilti Inc.
  5. Loos & Co.; Seismic Earthquake Division
  6. Mason Industries
  7. TOLCO Incorporated; a brand of NIBCO INC.
  8. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
  1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized -steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane

## Window Rock Office Building and Site CONSTRUCTION DOCUMENTS

methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

### 2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  - 1. Powder coating on springs and housings.
  - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
  - 3. Baked enamel or powder coat for metal components on isolators for interior use.
  - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

## PART 3 - EXECUTION

### 3.0 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Design Professional shall obtain equipment Center of Gravity and Weight data from manufacturers for equipment to be secured.
- C. Design restraints to comply with critical equipment manufacturers requirements and to achieve system operability as defined by manufacturer's certification design limits per Section 1.5 subpart A.2.
- D. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.1 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### 3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Conduit Support Restraints:
  - 1. Install transverse restraints at 30-foot intervals or both ends if the conduit run is less than 30 feet. Install transverse restraints at both ends and at 90° bends.
  - 2. Install longitudinal restraints at 60-foot intervals with at least one per conduit run.

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

3. Transverse restraints for one support may serve as the longitudinal brace for a perpendicular run if the restraint is within 4 feet of the intersection and the restraint are sized for the larger run.
4. Conduits less than 2.5 inches diameter suspended by individual hanger rods may be excluded from the above requirements.
5. Clevis or trapeze supported conduits suspended by hanger rods where the point of attachment is less than 12 inches in length from the conduit to the structural connection of the clevis or trapeze may be excluded from the above requirements.

B. Equipment Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
4. Equipment weighing less than 50 lbs may be excluded from the above requirements.

C. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

E. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### 3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

### 3.4 FIELD QUALITY CONTROL

16 77 30 - 7

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days advance notice.
  - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  - 5. Test to 90% of rated proof load of device.
  - 6. Measure isolator restraint clearance.
  - 7. Measure isolator deflection.
  - 8. Verify snubber minimum clearances.
  - 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports. Submit only original or first generation copies of test results. Faxes or illegible copies will not be acceptable.

### 3.5 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation. Air gaps shall not exceed 0.25 inch.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 167730

## SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

### 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:

- |   |  |
|---|--|
| <ul style="list-style-type: none"><li>1. Piping materials and installation instructions common to most piping systems.</li><li>2. Transition fittings.</li><li>3. Dielectric fittings.</li><li>4. Mechanical sleeve seals.</li><li>5. Sleeves.</li><li>6. Escutcheons.</li><li>7. Grout.</li><li>8. Equipment installation requirements common to equipment sections.</li></ul> | <ul style="list-style-type: none"><li>9. Equipment installation requirements common to owner provided equipment.</li><li>10. Connections to kitchen equipment.</li><li>11. Connections to equipment.</li><li>12. Painting and finishing.</li><li>13. Concrete bases.</li><li>14. Supports and anchorages.</li><li>15. Link Seal</li><li>16. Warranty</li></ul> |
|---|--|

#### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### 1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

- D. Coordinate the owner provided equipment with the general contractor, owner and architect. Provide all necessary pipes, fittings, etc for a complete installation. Owner provided equipment is identified on the architectural plans.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

## 2.4 TRANSITION FITTINGS

- A. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:  
ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
  - 1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Fernco, Inc.
    - c. Mission Rubber Company.
    - d. Plastic Oddities, Inc.

## 2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epco Sales, Inc.
    - e. Hart Industries, International, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.



- c. Epco Sales, Inc.
  - d. Watts Industries, Inc.; Water Products Div.
  
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  
  - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
  
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
  
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.
    - d. Victaulic Co. of America.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- D. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000-psi, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## 2.10 OWNER PROVIDED EQUIPMENT

- A. Make all connections to owner provided equipment.
  - 1. See architectural plans for owner provided equipment.
  - 2. Provide and install;
    - a. Shutoffs
    - b. P-traps
    - c. Risers
    - d. Supplies
    - e. Gas cocks
    - f. Flexible gas pipes
    - g. Tailpieces
  - 3. Owner provided equipment
    - a. Dishwashers
    - b. Icemakers
    - c. Ranges
    - d. Refrigerators
    - e. Clothes washers and dryers
    - f. Science room equipment

## 2.11 CONNECTIONS TO KITCHEN EQUIPMENT

- A. All kitchen equipment, unless specifically noted otherwise, shall be furnished by others. This contractor shall make all required hot water, cold water, waste, vent and gas rough-ins as shown on the kitchen and/or plumbing drawings and schedules and shall make all final connections.
- B. The kitchen equipment contractor shall provide complete rough-in drawings showing exact location of all stubs in floors and walls. It will be this contractor's responsibility to install all sleeves through walls and floors and to connect all plumbing services. This contractor shall request rough-in information well in advance of installation of equipment.
- C. Each hot water, cold water and gas connection to kitchen equipment shall include a valve and union and shall be capped for connection after equipment has been installed.
- D. Pipe sleeves shall be installed where piping rises through floors and shall be caulked with waterproof compound.
- E. The kitchen equipment contractor shall provide and install kitchen equipment, including faucets and sink wastes, swing faucets at kettles and ranges, strainers and tailpieces.
- F. The plumbing contractor shall provide cold water and hot water services, all interconnecting pipes, vacuum breaker, traps, etc., and shall make all final connections including installing indirect waste piping.

## 2.12 CONNECTIONS TO EQUIPMENT

- A. The Plumbing Contractor shall furnish all turrets, cocks, escutcheons, vacuum breakers, etc. Connections to mains shall be by this Plumbing Contractor.
- B. The Plumbing Contractor shall coordinate with the cabinet supplier the location of all sinks and counter top equipment. Final connections to be by the Plumbing Contractor.
- C. The Plumbing Contractor shall rough in all utility lines to the cabinets, tables, hoods, and terminate utilities with shutoff valve and waste and vent lines with caps. All such rough-ins shall be labeled. Final connections to be by the Plumbing Contractor.
- D. The cabinet supplier shall provide complete roughing in drawings showing the exact location of all stub-ups in floors and walls. It shall be the responsibility of the Plumbing Contractor to install all sleeves through walls and floors and to make all final connections. Piping through floors shall be sleeved, caulked, and flashed to prevent leakage should a leak occur.
- E. Piping for water, propane and air where required, shall be of 3/8-inch, 1/2-inch, or 3/4-inch IPS as required to provide full capacity at all fixtures or services outlets. All exposed piping, fittings, and hangers exposed on laboratory benches or tables shall be red metal of same composition as fixture and shall be chrome plated.

## 2.13 (NOT USED)

## 2.14 WARRANTY

- A. Description: All plumbing equipment, installation and systems shall be warranted for a period of 1 year from the date of substantial completion.

## PART 3 - EXECUTION

### 3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
  - 2. Existing Piping: Use the following:
    - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
    - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
    - f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
    - g. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
    - h. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.



- I. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- J. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### 3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.6 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### 3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### 3.10 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 220500



## **SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT**

### **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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

#### **1.3 COORDINATION**

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL MOTOR REQUIREMENTS**

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

#### **2.2 MOTOR CHARACTERISTICS**

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

## 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F>.
- J. Code Letter Designation:
  - 1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

## 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.

2. Split phase.
  3. Capacitor start, inductor run.
  4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

## **SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
1. Sleeves.
  2. Sleeve-seal systems.
  3. Grout.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

### **PART 2 - PRODUCTS**

#### **2.1 SLEEVES**

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

#### **2.2 SLEEVE-SEAL SYSTEMS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
  2. CALPICO, Inc.
  3. Metraflex Company (The).
  4. Pipeline Seal and Insulator, Inc.
  5. Proco Products, Inc.



- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Carbon steel.
  - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

### 2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  1. Exterior Concrete Walls above Grade:
    - a. Piping shall be Cast Iron or Galvanized pipe sleeves.
  2. Exterior Concrete Walls below Grade:
    - a. Piping shall be Cast Iron or Galvanized pipe sleeves.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  3. Concrete Slabs-on-Grade:
    - a. Piping shall be Cast Iron or Galvanized pipe sleeves.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  4. Concrete Slabs above Grade:
    - a. Piping shall be galvanized or PVC pipe sleeves.
  5. Interior Partitions:
    - a. Piping shall be galvanized or PVC pipe sleeves.

END OF SECTION 220517

## **SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

**A. Section Includes:**

1. Escutcheons.
2. Floor plates.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data:** For each type of product indicated.

### **PART 2 - PRODUCTS**

#### **2.1 ESCUTCHEONS**

- A. One-Piece, Cast-Brass Type:** With polished, chrome-plated and rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type:** Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type:** With chrome-plated finish and spring-clip fasteners.

#### **2.2 FLOOR PLATES**

- A. One-Piece Floor Plates:** Cast-iron flange with holes for fasteners.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.**
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.**
1. Escutcheons for New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
  - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
  - c. Insulated Piping: One-piece, stamped-steel type.
  - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast- brass type with polished, chrome-plated finish.
  - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
  - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
  - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
  - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.

### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

## **SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING**

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

##### A. Section Includes:

1. Bronze angle valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Iron, grooved-end butterfly valves.
5. Bronze lift check valves.
6. Bronze swing check valves.
7. Iron swing check valves.
8. Iron swing check valves with closure control.
9. Iron, grooved-end swing check valves.
10. Iron, center-guided check valves.
11. Iron, plate-type check valves.
12. Bronze gate valves.
13. Iron gate valves.
14. Bronze globe valves.
15. Iron globe valves.

##### B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set angle, gate, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 5. Set butterfly valves closed or slightly open.
  - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
  - 2. Handwheel: For valves other than quarter-turn types.
  - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
  - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
  - 1. Gate Valves: With rising stem.
  - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
  - 2. Grooved: With grooves according to AWWA C606.
  - 3. Solder Joint: With sockets according to ASME B16.18.
  - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

### 2.2 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Bronze Disc:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hammond Valve.
    - b. Milwaukee Valve Company.
  - 2. Description:



- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.

## 2.3 BRONZE BALL VALVES

### A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. Crane Co.; Crane Valve Group; Crane Valves.
  - d. Hammond Valve.
  - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
  - f. Legend Valve.
  - g. Milwaukee Valve Company.
  - h. NIBCO INC.
  - i. Red-White Valve Corporation.
  - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Bronze.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.

### B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Hammond Valve.
  - d. Lance Valves; a division of Advanced Thermal Systems, Inc.

- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

C. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. DynaQuip Controls.
- f. Hammond Valve.
- g. Lance Valves; a division of Advanced Thermal Systems, Inc.
- h. Milwaukee Valve Company.
- i. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

D. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Hammond Valve.
- d. Milwaukee Valve Company.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Regular.

E. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. DynaQuip Controls.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Red-White Valve Corporation.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

F. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.

- b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
2. Description:
- a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Three piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Stainless steel.
  - i. Ball: Stainless steel, vented.
  - j. Port: Full.

#### 2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

##### A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
  - d. Crane Co.; Crane Valve Group; Jenkins Valves.
  - e. Crane Co.; Crane Valve Group; Stockham Division.
  - f. DeZurik Water Controls.
  - g. Flo Fab Inc.
  - h. Hammond Valve.
  - i. Kitz Corporation.
  - j. Legend Valve.
  - k. Milwaukee Valve Company.
  - l. NIBCO INC.
  - m. Norriseal; a Dover Corporation company.
  - n. Red-White Valve Corporation.
  - o. Spence Strainers International; a division of CIRCOR International, Inc.
  - p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.

- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- d. Crane Co.; Crane Valve Group; Jenkins Valves.
- e. Crane Co.; Crane Valve Group; Stockham Division.
- f. DeZurik Water Controls.
- g. Flo Fab Inc.
- h. Hammond Valve.
- i. Kitz Corporation.
- j. Legend Valve.
- k. Milwaukee Valve Company.
- l. NIBCO INC.
- m. Norriseal; a Dover Corporation company.
- n. Red-White Valve Corporation.
- o. Spence Strainers International; a division of CIRCOR International, Inc.
- p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. American Valve, Inc.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- e. Crane Co.; Crane Valve Group; Center Line.
- f. Crane Co.; Crane Valve Group; Stockham Division.

- g. DeZurik Water Controls.
  - h. Flo Fab Inc.
  - i. Hammond Valve.
  - j. Kitz Corporation.
  - k. Legend Valve.
  - l. Milwaukee Valve Company.
  - m. Mueller Steam Specialty; a division of SPX Corporation.
  - n. NIBCO INC.
  - o. Norriseal; a Dover Corporation company.
  - p. Spence Strainers International; a division of CIRCOR International, Inc.
  - q. Sure Flow Equipment Inc.
  - r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
  - e. Seat: EPDM.
  - f. Stem: One- or two-piece stainless steel.
  - g. Disc: Nickel-plated or -coated ductile iron.
- D. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
  - b. American Valve, Inc.
  - c. Conbraco Industries, Inc.; Apollo Valves.
  - d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
  - e. Crane Co.; Crane Valve Group; Center Line.
  - f. Crane Co.; Crane Valve Group; Stockham Division.
  - g. DeZurik Water Controls.
  - h. Flo Fab Inc.
  - i. Hammond Valve.
  - j. Kitz Corporation.
  - k. Legend Valve.
  - l. Milwaukee Valve Company.
  - m. Mueller Steam Specialty; a division of SPX Corporation.
  - n. NIBCO INC.
  - o. Norriseal; a Dover Corporation company.
  - p. Spence Strainers International; a division of CIRCOR International, Inc.
  - q. Sure Flow Equipment Inc.
  - r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated **or -coated** ductile iron.

E. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. American Valve, Inc.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- e. Crane Co.; Crane Valve Group; Jenkins Valves.
- f. Crane Co.; Crane Valve Group; Stockham Division.
- g. DeZurik Water Controls.
- h. Flo Fab Inc.
- i. Hammond Valve.
- j. Kitz Corporation.
- k. Legend Valve.
- l. Milwaukee Valve Company.
- m. Mueller Steam Specialty; a division of SPX Corporation.
- n. NIBCO INC.
- o. Norriseal; a Dover Corporation company.
- p. Red-White Valve Corporation.
- q. Spence Strainers International; a division of CIRCOR International, Inc.
- r. Sure Flow Equipment Inc.
- s. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Stainless steel.

F. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ABZ Valves and Controls; A div. of ABZ Manufacturing, Inc.
  - b. American Valve, Inc.
  - c. Conbraco Industries, Inc.; Apollo Valves.
  - d. Cooper Cameron Valves; A div. of Cooper Cameron Corp.
  - e. Crane Co.; Crane Valve Group; Jenkins Valves.
  - f. Crane Co.; Crane Valve Group; Stockham Div.
  - g. DeZurik Water Controls.
  - h. Flo Fab Inc.
  - i. Hammond Valve.
  - j. Kitz Corporation.
  - k. Legend Valve.
  - l. Milwaukee Valve Company.
  - m. Mueller Steam Specialty; a division of SPX Corporation.
  - n. NIBCO INC.
  - o. Norriseal; a Dover Corporation company.
  - p. Red-White Valve Corporation.
  - q. Spence Strainers International; a division of CIRCOR International, Inc.
  - r. Sure Flow Equipment Inc.
  - s. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
  - e. Seat: NBR.
  - f. Stem: One- or two-piece stainless steel.
  - g. Disc: Stainless steel.

## 2.5 IRON, GROOVED-END BUTTERFLY VALVES

### A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Kennedy Valve; a division of McWane, Inc.
  - b. Shurjoint Piping Products.
  - c. Tyco Fire Products LP; Grinnell Mechanical Products.
  - d. Victaulic Company.
2. Description:
  - a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 175 psig.
  - c. Body Material: Coated, ductile iron.



- d. Stem: Two-piece stainless steel.
- e. Disc: Coated, ductile iron.
- f. Seal: EPDM.

B. 300 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International, Inc.
  - b. Kennedy Valve; a division of McWane, Inc.
  - c. Mueller Steam Specialty; a division of SPX Corporation.
  - d. NIBCO INC.
  - e. Shurjoint Piping Products.
  - f. Tyco Fire Products LP; Grinnell Mechanical Products.
  - g. Victaulic Company.
2. Description:
  - a. Standard: MSS SP-67, Type I.
  - b. NPS 8 and Smaller CWP Rating: 300 psig.
  - c. NPS 10 and Larger CWP Rating: 200 psig.
  - d. Body Material: Coated, ductile iron.
  - e. Stem: Two-piece stainless steel.
  - f. Disc: Coated, ductile iron.
  - g. Seal: EPDM.

2.6 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
2. Description:
  - a. Standard: MSS SP-80, Type 1.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Vertical flow.
  - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: Bronze.

## 2.7 BRONZE SWING CHECK VALVES

### A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. Hammond Valve.
  - f. Kitz Corporation.
  - g. Milwaukee Valve Company.
  - h. NIBCO INC.
  - i. Powell Valves.
  - j. Red-White Valve Corporation.
  - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - l. Zy-Tech Global Industries, Inc.
2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: Bronze.

### B. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. Kitz Corporation.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Red-White Valve Corporation.
  - i. Zy-Tech Global Industries, Inc.
2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 300 psig.
  - c. Body Design: Horizontal flow.

- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

## 2.8 IRON SWING CHECK VALVES

### A. Class 125, Iron Swing Check Valves with Metal Seats:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Kitz Corporation.
  - f. Legend Valve.
  - g. Milwaukee Valve Company.
  - h. NIBCO INC.
  - i. Powell Valves.
  - j. Red-White Valve Corporation.
  - k. Sure Flow Equipment Inc.
  - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - m. Zy-Tech Global Industries, Inc.

### 2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

### B. Class 250, Iron Swing Check Valves with Metal Seats:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 500 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

2.9 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. NIBCO INC.
- 2. Description:
  - a. Standard: MSS SP-71, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Clear or full waterway.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged.
  - f. Trim: Bronze.
  - g. Gasket: Asbestos free.
  - h. Closure Control: Factory-installed, exterior lever and spring.

2.10 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International, Inc.
  - b. Shurjoint Piping Products.
  - c. Tyco Fire Products LP; Grinnell Mechanical Products.
  - d. Victaulic Company.
- 2. Description:
  - a. CWP Rating: 300 psig.
  - b. Body Material: ASTM A 536, ductile iron.
  - c. Seal: EPDM.

- d. Disc: Spring-operated, ductile iron or stainless steel.

## 2.11 IRON, CENTER-GUIDED CHECK VALVES

### A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International, Inc.
  - b. APCO Willamette Valve and Primer Corporation.
  - c. Crispin Valve.
  - d. DFT Inc.
  - e. Flo Fab Inc.
  - f. GA Industries, Inc.
  - g. Hammond Valve.
  - h. Metraflex, Inc.
  - i. Milwaukee Valve Company.
  - j. Mueller Steam Specialty; a division of SPX Corporation.
  - k. NIBCO INC.
  - l. Spence Strainers International; a division of CIRCOR International, Inc.
  - m. Sure Flow Equipment Inc.
  - n. Val-Matic Valve & Manufacturing Corp.
  - o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-125.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM A 126, gray iron.
  - d. Style: Compact wafer.
  - e. Seat: Bronze.

### B. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. APCO Willamette Valve and Primer Corporation.
  - b. Crispin Valve.
  - c. Val-Matic Valve & Manufacturing Corp.
2. Description:
  - a. Standard: MSS SP-125.
  - b. CWP Rating: 300 psig.
  - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
  - d. Style: Compact wafer.

e. Seat: Bronze.

C. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crispin Valve.
- c. DFT Inc.
- d. Flo Fab Inc.
- e. Hammond Valve.
- f. Metraflex, Inc.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Sure Flow Equipment Inc.
- j. Val-Matic Valve & Manufacturing Corp.

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 400 psig.
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Compact wafer, spring loaded.
- e. Seat: Bronze.

D. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crispin Valve.
- c. Val-Matic Valve & Manufacturing Corp.

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 500 psig.
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Compact wafer, spring loaded.
- e. Seat: Bronze.

## 2.12 IRON, PLATE-TYPE CHECK VALVES

A. Class 125, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. APCO Willamette Valve and Primer Corporation.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Flomatic Corporation.
  - d. Mueller Steam Specialty; a division of SPX Corporation.

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 200 psig.
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 126, gray iron.
- e. Seat: Bronze.

B. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. APCO Willamette Valve and Primer Corporation.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Mueller Steam Specialty; a division of SPX Corporation.
  - d. Val-Matic Valve & Manufacturing Corp.

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 300 psig.
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- e. Seat: Bronze.

C. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. APCO Willamette Valve and Primer Corporation.
  - b. Crane Co.; Crane Valve Group; Crane Valves.

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 400 psig.
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 126, gray iron.
- e. Seat: Bronze.

D. Class 300, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. APCO Willamette Valve and Primer Corporation.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Mueller Steam Specialty; a division of SPX Corporation.
  - d. Val-Matic Valve & Manufacturing Corp.
2. Description:
  - a. Standard: API 594.
  - b. CWP Rating: 500 psig.
  - c. Body Design: Wafer, spring-loaded plates.
  - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
  - e. Seat: Bronze.

E. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. APCO Willamette Valve and Primer Corporation.
  - b. Cooper Cameron Valves TVB Techno.
  - c. Crane Co.; Crane Valve Group; Crane Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. NIBCO INC.
  - f. Spence Strainers International; a division of CIRCOR International, Inc.
  - g. Sure Flow Equipment Inc.
  - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: API 594.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Wafer, spring-loaded plates.
  - d. Body Material: ASTM A 126, gray iron.
  - e. Seat: EPDM or NBR.

F. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. APCO Willamette Valve and Primer Corporation.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Val-Matic Valve & Manufacturing Corp.



2. Description:

- a. Standard: API 594.
- b. CWP Rating: 300 psig.
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- e. Seat: EPDM or NBR.

G. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Sure Flow Equipment Inc.

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 400 psig.
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 126, gray iron.
- e. Seat: EPDM or NBR.

H. Class 300, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. APCO Willamette Valve and Primer Corporation.
- b. Val-Matic Valve & Manufacturing Corp.

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 500 psig.
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- e. Seat: EPDM or NBR.

## 2.13 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Flo Fab Inc.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Legend Valve.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Powell Valves.
- k. Red-White Valve Corporation.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Flo Fab Inc.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Legend Valve.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Powell Valves.
- k. Red-White Valve Corporation.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.

- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

C. Class 250, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. NIBCO INC.
2. Description:
  - a. Standard: MSS SP-70, Type I.
  - b. CWP Rating: 500 psig.
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Disc: Solid wedge.
  - g. Packing and Gasket: Asbestos free.

D. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. Hammond Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Powell Valves.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-70, Type I.
  - b. CWP Rating: 500 psig.
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Disc: Solid wedge.
  - g. Packing and Gasket: Asbestos free.

## 2.14 BRONZE GLOBE VALVES

### A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. Hammond Valve.
  - d. Kitz Corporation.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Powell Valves.
  - h. Red-White Valve Corporation.
  - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - j. Zy-Tech Global Industries, Inc.
2. Description:
  - a. Standard: MSS SP-80, Type 1.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
  - d. Ends: Threaded or solder joint.
  - e. Stem and Disc: Bronze.
  - f. Packing: Asbestos free.
  - g. Handwheel: Malleable iron, bronze, or aluminum.

## 2.15 IRON GLOBE VALVES

### A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Kitz Corporation.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Powell Valves.
  - i. Red-White Valve Corporation.
  - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - k. Zy-Tech Global Industries, Inc.
2. Description:

- a. Standard: MSS SP-85, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

B. Class 250, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-85, Type I.
  - b. CWP Rating: 500 psig.
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Packing and Gasket: Asbestos free.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
  - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
  - 3. Lift Check Valves: With stem upright and plumb.

### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly, or gate valves.
  - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  - 3. Throttling Service Globe, angle, ball or butterfly valves.
  - 4. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
    - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

### 3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

#### A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One, Two, or Three piece, full, regular or reduced port, with brass, bronze or stainless-steel trim.
3. Bronze Lift Check Valves: Class 125, bronze disc.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Gate Valves: Class 125, RS.

#### B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron, Grooved-End Swing Check Valves: 300 CWP.
5. Iron, Center-Guided Check Valves: Class 125, globe, metal seat.
6. Iron, Plate-Type Check Valves: Class 125; dual plate; metal seat.
7. Iron Gate Valves: Class 125, OS&Y.

### 3.6 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

#### A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125 or Class 150, bronze disc.
3. Ball Valves: One, Two or Three piece, full or, regular port, bronze with bronze or stainless-steel trim.
4. Bronze Swing Check Valves: Class 125 or Class 150, bronze disc.
5. Bronze Globe Valves: Class 125 or Class 150, bronze disc.

#### B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Ball Valves: One, Two or Three piece, full or, regular port, bronze with bronze or stainless-steel trim.

3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM or NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
4. Iron, Grooved-End Butterfly Valves: 175 or 300 CWP.
5. Iron Swing Check Valves: Class 125 or Class 250, metal seats.
6. Iron Swing Check Valves with Closure Control: Class 125, lever and spring weight.
7. Iron, Grooved-End Swing Check Valves: 300 CWP.
8. Iron, Center-Guided Check Valves: Class 125, Class 150, Class 250 or Class 300, compact-wafer, metal seat.
9. Iron, Plate-Type Check Valves: Class 125, Class 150, Class 250 or Class 300; single plate; metal seat.
10. Iron Gate Valves: Class 125 or Class 250, NRS or OS&Y.
11. Iron Globe Valves: Class 125 or Class 250.

END OF SECTION 220523



## **SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

### **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 hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

- B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

#### **1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment.

## 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Thermal-hanger shield inserts.
  - 3. Powder-actuated fastener systems.
  - 4. Pipe positioning systems.
  - 5. Mechanical Anchors: ICC-ES Evaluation Reports validating 'Cracked Concrete' testing per A.C. 193 must be provided for anchors resisting seismic loads and/or supporting life-safety systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers. Include Product Data for components.
  - 2. Metal framing systems. Include Product Data for components.
  - 3. Pipe stands. Include Product Data for components.
  - 4. Equipment supports.
- C. Welding certificates.

## 1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel.", AWS D1.4, "Structural Welding Code--Reinforcing Steel." and ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. AWS D1.2, "Structural Welding Code--Aluminum."
  - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
  - 4. ASME Boiler and Pressure Vessel Code: Section IX.

## 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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
  1. AAA Technology & Specialties Co., Inc.
  2. Bergen-Power Pipe Supports.
  3. B-Line Systems, Inc.; a division of Cooper Industries.
  4. Carpenter & Paterson, Inc.
  5. Empire Industries, Inc.
  6. ERICO/Michigan Hanger Co.
  7. Globe Pipe Hanger Products, Inc.
  8. Grinnell Corp.
  9. GS Metals Corp.
  10. National Pipe Hanger Corporation.
  11. PHD Manufacturing, Inc.
  12. PHS Industries, Inc.
  13. Piping Technology & Products, Inc.
  14. Tolco Inc.
  15. Simpson Strong-Tie Co.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

## 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

## 2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
  2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
  3. GS Metals Corp.
  4. Hilti, Inc.
  5. Power-Strut Div.; Tyco International, Ltd.
  6. Thomas & Betts Corporation.
  7. Tolco Inc.
  8. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

## 2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
1. Carpenter & Paterson, Inc.
  2. ERICO/Michigan Hanger Co.
  3. PHS Industries, Inc.
  4. Pipe Shields, Inc.
  5. Rilco Manufacturing Company, Inc.
  6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:

- a. Hilti, Inc.
  - b. MKT Fastening, LLC.
  - c. Powers Fasteners.
  - d. Simpson Strong-Tie Co.
- B. Mechanical-Expansion Anchors and Concrete Screws: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. For anchors resisting seismic loads and/or supporting life- safety systems, Anchors shall have been tested for 'Cracked Concrete' per A.C. 193 per a valid ICC-ES Evaluation Report. Manufacturers with these anchors have been designated below with: '\*'
1. Manufacturers:
    - a. B-Line Systems, Inc.; a division of Cooper Industries.
    - b. Empire Industries, Inc.
    - c. Hilti, Inc.
    - d. ITW Ramset/Red Head.
    - e. MKT Fastening, LLC.
    - f. Powers Fasteners.
    - g. Simpson Strong-Tie Co. \*

## 2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
1. Manufacturers:
    - a. ERICO/Michigan Hanger Co.
    - b. MIRO Industries.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
1. Manufacturers:
    - a. MIRO Industries.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
1. Manufacturers:
    - a. ERICO/Michigan Hanger Co.

- b. MIRO Industries.
    - c. Portable Pipe Hangers.
  - 2. Base: Stainless steel.
  - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
- 1. Manufacturers:
    - a. Portable Pipe Hangers.
  - 2. Bases: One or more plastic.
  - 3. Vertical Members: Two or more protective-coated-steel channels.
  - 4. Horizontal Member: Protective-coated-steel channel.
  - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

## 2.8 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Manufacturers:
  - 1. C & S Mfg. Corp.
  - 2. HOLDRITE Corp.; Hubbard Enterprises.
  - 3. Samco Stamping, Inc.

## 2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

## 2.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
  10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
  11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
  16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18 or Simpson Blue Banger Concrete insert with UL & FM approvals): For upper attachment to suspend pipe hangers from concrete ceiling.



2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
  - a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): Mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
  1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Powder actuated fasteners shall not be used for seismic bracing attachments.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. For anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems, anchors shall have been tested for 'Cracked Concrete' per A.C. 193 and shall have a valid ICC-ES Evaluation Report
- F. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

- O. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  5. Pipes NPS 8 and Larger: Include wood inserts.
  6. Insert Material: Length at least as long as protective shield.
  7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports. For applications where seismic bracing is required, 'Cracked Concrete' expansion anchors or concrete screws tested per A.C. 193 must be provided for seismic bracing anchorage where post-installed anchors are required.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

### 3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

**SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT**

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 seismic restraints and vibration isolation as defined in Section 230548 for the following:
  - 1. Plumbing Piping.
  - 2. Skid mounted domestic water heating and tempering package.
  - 3. Storage tank.
  - 4. Domestic water expansion tank.
  - 5. In-line domestic water circulating pumps.
  - 6. Grease removal unit.

PART 2 - PRODUCTS

2.1 (NOT USED) PART 3 - EXECUTION

## **SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

### **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. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

#### **1.4 COORDINATION**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT LABELS

#### A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Blue.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

### 2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater



viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

## 2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
  - 1. Stencil Material: Fiberboard or metal.
  - 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

## 2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.

- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

- 1. Valve-tag schedule shall be included in operation and maintenance data.

## 2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

- 1. Size: 3 by 5-1/4 inches minimum.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: Yellow background with black lettering.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.

- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
  
- D. Pipe Label Color Schedule:
  - 1. Domestic Water Piping:
    - a. Background Color: Yellow
    - b. Letter Color: Black
  
  - 2. Storm Drainage Piping:
    - a. Background Color: Green
    - b. Letter Color: White

### 3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
  
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Size and Shape:
    - a. Cold Water: 1-1/2 inches, round.
    - b. Hot Water: 1-1/2 inches, round.
    - c. Low-Pressure Compressed Air: 1-1/2 inches, round.
    - d. High-Pressure Compressed Air: 1-1/2 inches, round.
  
  - 2. Valve-Tag Color:
    - a. Cold Water: Comply with ASME A13.1.
    - b. Hot Water: Comply with ASME A13.1.

- c. Low-Pressure Compressed Air: Comply with ASME A13.1.
- d. High-Pressure Compressed Air: Comply with ASME A13.1.

3. Letter Color:

- a. Cold Water: Comply with ASME A13.1.
- b. Hot Water: Comply with ASME A13.1.
- c. Low-Pressure Compressed Air: Comply with ASME A13.1.
- d. High-Pressure Compressed Air: Comply with ASME A13.1.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

## SECTION 220700 - PLUMBING INSULATION

### 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. Insulation Materials:
  - a. Flexible elastomeric.
  - b. Mineral fiber.
- 2. Adhesives.
- 3. Lagging adhesives.
- 4. Sealants.
- 5. Factory-applied jackets.
- 6. Field-applied fabric-reinforcing mesh.
- 7. Field-applied jackets.
- 8. Tapes.
- 9. Securements.
- 10. Corner angles.

- B. Related Sections include the following:

- 1. Division 23 Section "HVAC Insulation."

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

- B. Shop Drawings:

- 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
- 2. Detail attachment and covering of heat tracing inside insulation.
- 3. Detail insulation application at pipe expansion joints for each type of insulation.
- 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.

- C. Qualification Data: For qualified Installer.
- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- E. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

## 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; All-Service Duct Wrap.

- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.
- I. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fibrex Insulations Inc.; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000(Pipe Insulation.
    - d. Manson Insulation Inc.; Alley-K.
    - e. Owens Corning; Fiberglas Pipe Insulation.
  2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; CrimpWrap.
    - b. Johns Manville; MicroFlex.
    - c. Knauf Insulation; Pipe and Tank Insulation.
    - d. Manson Insulation Inc.; AK Flex.
    - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

## 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.



- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; Aero seal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
  
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
  
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
  
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company (The); 739, Dow Silicone.
    - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Red Devil, Inc.; Celulon Ultra Clear.
    - e. Speedline Corporation; Speedline Vinyl Adhesive.

### 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
  
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-35.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    - c. ITW TACC, Division of Illinois Tool Works; CB-50.
    - d. Marathon Industries, Inc.; 590.
    - e. Mon-Eco Industries, Inc.; 55-40.
    - f. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; Encacel.
    - b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
    - c. Marathon Industries, Inc.; 570.
    - d. Mon-Eco Industries, Inc.; 55-70.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
  3. Service Temperature Range: Minus 50 to plus 220 deg F.
  4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  5. Color: White.

## 2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-52.
    - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
    - c. Marathon Industries, Inc.; 130.
    - d. Mon-Eco Industries, Inc.; 11-30.
    - e. Vimasco Corporation; 136.
  2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
  3. Service Temperature Range: Minus 50 to plus 180 deg F.
  4. Color: White.

## 2.5 SEALANTS

### A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-76-8.
  - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

### B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

## 2.6 FACTORY-APPLIED JACKETS

### A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
  - a. Products: Subject to compliance with requirements, provide the following:
    - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
  - a. Products: Subject to compliance with requirements, provide the following:
    - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
  - a. Products: Subject to compliance with requirements, provide the following:
    - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

## 2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto PVC Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
  5. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; Metal Jacketing Systems.
    - b. PABCO Metals Corporation; Surefit.

- c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
- a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
  - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    - b. Compac Corp.; 104 and 105.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  - 2. Width: 3 inches.
  - 3. Thickness: 11.5 mils.
  - 4. Adhesion: 90 ounces force/inch in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch in width.
  - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
- 1. Products: Subject to compliance with requirements, provide one of the following:

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
  - b. Compac Corp.; 110 and 111.
  - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
  - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. Venture Tape; 1506 CW NS.
  2. Width: 2 inches.
  3. Thickness: 6 mils.
  4. Adhesion: 64 ounces force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

## 2.9 SECUREMENTS

### A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products; Bands.
  - b. PABCO Metals Corporation; Bands.
  - c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

### B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; CD.
    - 3) Midwest Fasteners, Inc.; CD.
    - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; Cupped Head Weld Pin.
    - 3) Midwest Fasteners, Inc.; Cupped Head.
    - 4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Aluminum or Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
    - 2) GEMCO; Press and Peel.
    - 3) Midwest Fasteners, Inc.; Self Stick.
  - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Aluminum or Stainless steel], fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum or stainless-steel] sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; RC-150.
    - 2) GEMCO; R-150.
    - 3) Midwest Fasteners, Inc.; WA-150.
    - 4) Nelson Stud Welding; Speed Clips.
  - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.



- D. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, stainless steel.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C & F Wire.
    - b. Childers Products.
    - c. PABCO Metals Corporation.
    - d. RPR Products, Inc.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

#### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

- install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):  
Install insulation continuously through walls and partitions.

### 3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.
    - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    - d. Do not overcompress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins and attach speed washers.
    - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum or stainless steel, at least 0.040 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

### 3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe

insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.8 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.



- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- D. Where PVDC jackets are indicated, install as follows:
  - 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
  - 2. Wrap factory-presize jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presize jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
  - 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
  - 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
  - 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

### 3.10 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.11 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Steam-to-hot-water converter insulation shall be one of the following:
  - 1. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
  - 2. Mineral-Fiber Pipe and Tank: 2 inches thick.
- D. Domestic water pump insulation shall be the following:
  - 1. Mineral-Fiber Board: 1 inch thick and 2-lb/cu. ft. nominal density.
- E. Domestic hot-water pump insulation shall be the following:
  - 1. Mineral-Fiber Board: 1 inch thick and 2-lb/cu. ft. nominal density.
- F. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be one of the following:
  - 1. Mineral-Fiber Board: 1 inch thick and 2-lb/cu. ft. nominal density.
  - 2. Mineral-Fiber Pipe and Tank: 1 inch thick.

### 3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:

1. NPS 1-1/2 and Smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch
  2. NPS 2 and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
1. NPS 1-1/2 and Smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.
  2. NPS 2 and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- C. Domestic Chilled Water (Potable):
1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.
- D. Stormwater and Overflow:
1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.
- E. Roof Drain and Overflow Drain Bodies:
1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.
- F. Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1-1/2 and Smaller: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch

2. NPS 2 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. PVC: 20 mils thick.

END OF SECTION 220700

## SECTION 221116 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
  - 2. Encasement for piping.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

#### 1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."
- C. All piping shall be American made and tested; no import pipe will be permitted.
- D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.
- E. All piping installed in or passing through a plenum must be plenum rated, fire wrapped, or installed in a metal conduit.

### 2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Solder-joint or threaded ends.
- G. Copper Pressure-Seal-Joint Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elkhart Products Corporation.
    - b. NIBCO Inc.
    - c. Viega.
  - 2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

H. Appurtenances for Grooved-End Copper Tubing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International.
  - b. Shurjoint Piping Products.
  - c. Victaulic Company.
2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
3. Mechanical Couplings for Grooved-End Copper Tubing:
  - a. Copper-tube dimensions and design similar to AWWA C606.
  - b. Ferrous housing sections.
  - c. EPDM-rubber gaskets suitable for hot and cold water.
  - d. Bolts and nuts.
  - e. Minimum Pressure Rating: 300 psig

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 ENCASUREMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

## 2.5 TRANSITION FITTINGS

- A. General Requirements:
  - 1. Same size as pipes to be joined.
  - 2. Pressure rating at least equal to pipes to be joined.
  - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cascade Waterworks Manufacturing.
    - b. Dresser, Inc.; Piping Specialties Products.
    - c. Ford Meter Box Company, Inc. (The).
    - d. JCM Industries.
    - e. Romac Industries, Inc.
    - f. Smith-Blair, Inc.; a Sensus company.
    - g. Viking Johnson.

## 2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Flanges:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
    - b. Central Plastics Company.
    - c. Matco-Norca.
    - d. Watts; a division of Watts Water Technologies, Inc.
    - e. Wilkins; a Zurn company.
  - 2. Standard: ASSE 1079.
  - 3. Factory-fabricated, bolted, companion-flange assembly.
  - 4. Pressure Rating: 175 psig minimum at 180 deg F.
  - 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- C. Dielectric-Flange Insulating Kits:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.



- b. Calpico, Inc.
  - c. Central Plastics Company.
  - d. Pipeline Seal and Insulator, Inc.
2. Nonconducting materials for field assembly of companion flanges.
  3. Pressure Rating: 150 psig.
  4. Gasket: Neoprene or phenolic.
  5. Bolt Sleeves: Phenolic or polyethylene.
  6. Washers: Phenolic with steel backing washers.
- D. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elster Perfection Corporation.
    - b. Grinnell Mechanical Products; Tyco Fire Products LP.
    - c. Matco-Norca.
    - d. Precision Plumbing Products, Inc.
    - e. Victaulic Company.
  2. Standard: IAPMO PS 66.
  3. Electroplated steel nipple complying with ASTM F 1545.
  4. Pressure Rating and Temperature: 300 psig at 225 deg F.
  5. End Connections: Male threaded or grooved.
  6. Lining: Inert and noncorrosive, propylene.

### PART 3 - EXECUTION

#### 3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

#### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure

gages in Division 22 Section "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Division 22 Section "Domestic Water Piping Specialties."

- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Division 22 Section "Domestic Water Piping Specialties."
- G. Install domestic water piping plumb and level.
  - 1. Install domestic water piping with 0.25 percent slope downward toward drain in areas that will be drained seasonally for freeze protection.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping."
- S. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Division 22 Section "Domestic Water Pumps."
- T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Division 22 Section "Meters and Gages for Plumbing Piping."

- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- H. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- I. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Square cut or roll groove ends of pipe as specified. Lubricate and install gasket over ends of

pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

- J. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

### 3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  6. NPS 6: 10 feet with 5/8-inch rod.
  7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code. Comply with requirements for connection sizes in Division 22 plumbing fixture Sections.
  4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Division 22 Section "Identification for Plumbing Piping and Equipment."

- B. Label pressure piping with system operating pressure.

### 3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

- 1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
  - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
  - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- 2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

- B. Domestic water piping will be considered defective if it does not pass tests and inspections.

- C. Prepare test and inspection reports.

### 3.10 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
  2. Open shutoff valves to fully open position.
  3. Open throttling valves to proper setting.
  4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.12 PIPING SCHEDULE

- A. Some piping types and sizes mentioned in this section may not be used on this project.
- B. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- C. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.
- E. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be one of the following:
  1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
  2. PP, SDR 7.4 and SDR 11 socket fittings; and fusion-welded joints.
- F. Under-building-slab, domestic water service main piping, NPS 4 to NPS 12 , shall be one of the following:
  1. Ames Stainless Steel 304 SST, In-Building Riser.
- G. Above ground domestic water piping, NPS 2 and smaller , shall be one of the following:
  1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
  2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- H. Above ground domestic water piping, NPS 2-1/2 to NPS 4 , shall be one of the following:
  1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
  2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.



Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

3. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.
- I. Above ground domestic water piping, NPS 5 and larger , shall be one of the following:
    1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
    2. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.

3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  1. Shutoff Duty: Use ball valves for piping NPS 3 and smaller. Use butterfly or ball, with flanged ends for piping NPS 4 and larger.
  2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
  3. Hot-Water Circulation Piping, Balancing Duty: Calibrated memory-stop balancing valves.
  4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

## **SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES**

### **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 domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose bibbs.
9. Wall hydrants.
10. Drain valves.
11. Water hammer arresters.

- B. Related Sections include the following:

1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.

- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
  - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
  - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

#### PART 2 - PRODUCTS

##### 2.1 (NOT USED)

2.2 (NOT USED)

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators: (Direct Type)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Conbraco Industries, Inc.
  - c. Honeywell Water Controls.
  - d. Watts Industries, Inc.; Water Products Div.
  - e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze, provide chrome-plated finish if connected to chrome plated or stainless steel piping for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water Control Valves: (Pilot type)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CLA-VAL Automatic Control Valves.
  - b. Watts Industries, Inc.; Ames Fluid Control Systems.
  - c. Watts Industries, Inc.; Watts ACV.
  - d. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

## 2.4 BALANCING VALVES

### A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc.
  - b. Flo Fab Inc.
  - c. ITT Industries; Bell & Gossett Div.
  - d. NIBCO INC.
  - e. TAC Americas.
  - f. Taco, Inc.
  - g. Victaulic
  - h. Watts Industries, Inc.; Water Products Div.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: bronze,
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

### B. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc.
  - b. Flo Fab Inc.
  - c. ITT Industries; Bell & Gossett Div.
  - d. NIBCO INC.
  - e. TAC Americas.
  - f. Watts Industries, Inc.; Water Products Div.
2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

### C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

## 2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

### A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc.

- b. Bradley
  - c. Conbraco Industries, Inc.
  - d. Honeywell Water Controls.
  - e. Legend Valve.
  - f. Leonard Valve Company.
  - g. Powers; a Watts Industries Co.
  - h. Symmons Industries, Inc.
  - i. Taco, Inc.
  - j. Watts Industries, Inc.; Water Products Div.
  - k. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1017.
  3. Pressure Rating: 125 psig.
  4. Type: Thermostatically controlled water mixing valve.
  5. Material: Bronze body with corrosion-resistant interior components.
  6. Connections: Threaded union inlets and outlet.
  7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
  8. Valve Finish: Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc.
  - b. Lawler Manufacturing Company, Inc.
  - c. Leonard Valve Company.
  - d. Powers; a Watts Industries Co.
  - e. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
9. Valve Finish: Chrome plated.
10. Piping Finish: Copper.

C. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Conbraco Industries, Inc.

- c. Honeywell Water Controls.
- d. Lawler Manufacturing Company, Inc.
- e. Leonard Valve Company.
- f. Powers; a Watts Industries Co.
- g. Watts Industries, Inc.; Water Products Div.
- h. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

2.6 (NOT USED)

2.7 (NOT USED)

2.8 (NOT USED)

## 2.9 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants:

1. Basis of Design: See the plumbing fixture schedule on the drawings.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. JR Smith.
  - b. Wade.
  - c. Watts.
  - d. Zurn.
3. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
4. Pressure Rating: 125 psig.
5. Operation: Loose key.
6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
7. Inlet: NPS 3/4 or NPS 1.
8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
9. Box: Deep, flush mounting with cover.
10. Box and Cover Finish: Polished nickel bronze.
11. Operating Keys: Two with each wall hydrant.

## 2.10 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.11 WATER HAMMER ARRESTERS

### A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. PPP Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - g. Tyler Pipe; Wade Div.
  - h. Watts Drainage Products Inc.
  - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.



1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- C. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install thermometers and water regulators if specified.
  2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- H. Install water hammer arresters in water piping according to PDI-WH 201.
- I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- J. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- K. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.
- 3.2 CONNECTIONS
- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Pressure vacuum breakers.
  - 2. Reduced-pressure-principle backflow preventers.
  - 3. Double-check backflow-prevention assemblies.
  - 4. Carbonated-beverage-machine backflow preventers.
  - 5. Dual-check-valve backflow preventers.
  - 6. Water pressure-reducing valves.
  - 7. Calibrated balancing valves.
  - 8. Primary, thermostatic, water mixing valves.
  - 9. Primary water tempering valves.
  - 10. Outlet boxes.
  - 11. Supply-type, trap-seal primer valves.
  - 12. Trap-seal primer systems.
  
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
  - 1. Test each backflow preventer according to authorities having jurisdiction and the device's reference standard.
  
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

### 3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
  
- B. Set field-adjustable flow set points of balancing valves.
  
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

## SECTION 221316 - SANITARY WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
  - 1. Pipe, tube, and fittings.
  - 2. Special pipe fittings.

#### 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. NBR: Acrylonitrile-butadiene rubber.
- D. PVC: Polyvinyl chloride plastic.
- E. TPE: Thermoplastic elastomer.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to 2009 International Building Code.

#### 1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
- C. Field quality-control inspection and test reports.

## 1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

## 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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

### 2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301. All waste, vent, sewer and storm lines shall be soil pipe and fittings that conform to the requirements of CISPI Standard 301, ASTM A \*\* and shall be marked with the collective trademark of the Cast Soil Pipe Institute or Receive Prior approval of the engineer and manufactured by AB&I Foundry, Tyler Pipe, or Charlotte Pipe. In addition all Cast iron shall be American made and tested, no "non compliant" import cast iron will be permitted.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
    - a. Manufacturers:

- 1) ANACO.
  - 2) Fernco, Inc.
  - 3) Ideal Div.; Stant Corp.
  - 4) Mission Rubber Co.
  - 5) Tyler Pipe; Soil Pipe Div.
2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- a. Manufacturers:
    - 1) ANACO.
    - 2) Clamp-All Corp.
    - 3) Ideal Div.; Stant Corp.
    - 4) Mission Rubber Co.
    - 5) Tyler Pipe; Soil Pipe Div.

#### 2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

#### 2.5 SPECIAL PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
1. Manufacturers:
    - a. Dallas Specialty & Mfg. Co.
    - b. Fernco, Inc.
    - c. Logan Clay Products Company (The).
    - d. Mission Rubber Co.
    - e. NDS, Inc.
    - f. Plastic Oddities, Inc.
  2. Sleeve Materials:
    - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
    - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
    - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - 1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Mission Rubber Co.

### PART 3 - EXECUTION

#### 3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

#### 3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
  - 1. Hubless cast-iron soil pipe and fittings standard, shielded, stainless-steel couplings; and hubless-coupling joints.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be the following:
  - 1. Hubless cast-iron soil pipe and fittings and heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
- D. Aboveground, vent piping NPS 4 and smaller shall be the following:
  - 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
- E. Underground, soil, waste, and vent piping shall be the following (to 6" above finished floor):
  - 1. Solid wall PVC pipe, PVC sockets fittings, and solvent-cemented joints.

#### 3.3 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- K. Install engineered soil and waste drainage and vent piping systems as follows:
  - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- L. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing. All penetrations shall extend 2" above the floor.
- M. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.

- N. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- O. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Install individual, straight, horizontal piping runs according to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:



1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

### 3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

### 3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

## SECTION 221320 - SANITARY WASTE PIPING SPECIALTIES

### 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 sanitary drainage piping specialties:
  - 1. Cleanouts.
  - 2. Floor drains.
  - 3. Channel drainage systems.
  - 4. Roof flashing assemblies.
  - 5. Through-penetration firestop assemblies.
  - 6. Miscellaneous sanitary drainage piping specialties.
  - 7. Flashing materials.
- B. Related Sections include the following:
  - 1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

#### 1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. HDPE: High-density polyethylene plastic.
- C. PE: Polyethylene plastic.
- D. PP: Polypropylene plastic.
- E. PVC: Polyvinyl chloride plastic.

#### 1.4 SUBMITTALS

- A. Product Data: (NOT USED)

- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that FOG disposal systems, grease interceptors, grease removal devices, oil interceptors, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

#### 1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

- B. Coordinate size and location of roof penetrations.

## PART 2 - PRODUCTS

### 2.1 CLEANOUTS

#### A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Sioux Chief Manufacturing Company, Inc
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

#### B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. Oatey.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Light Commercial Operation.
  - h. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.

8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Sioux Chief Manufacturing Company, Inc
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: See Schedule at end of this Section:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Sioux Chief Manufacturing Company, Inc
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.

g. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Standard: ASME A112.6.3.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Not required.
7. Outlet: Bottom.
8. Trap Material: Cast iron>.
9. Trap Pattern: Deep-seal P-trap>.
10. Trap Features: Trap-seal primer valve drain connection>.

2.3 (NOT USED)

2.4 (NOT USED)

## 2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

### A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
  - a. NPS 2: 4-inch- minimum water seal.
  - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

### B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

### C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

### D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top



of fitting that will extend 1 inch > above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.

2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Cap Filters:

1. Description: Activated carbon filter in housing for installation at vent terminal as manufactured by Sweet Filter.
2. Size: Same as connected stack vent or vent stack.

## 2.6 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

C. Fasteners: Metal compatible with material and substrate being fastened.

D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## 2.7 (NOT USED)

## 2.8 MOTORS

- A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

## PART 3 - EXECUTION

### 3.1 CONCRETE BASES

### 3.2 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.
  - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position floor drains for easy access and maintenance.
  - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
  - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- H. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
  - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  - 2. Size: Same as floor drain inlet.

- J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- L. Install vent cap filters on each vent pipe passing through roof.
- M. Install grease removal devices on floor as required by the manufacturer complete with all controls and power wiring.
- N. Install wood-blocking reinforcement for wall-mounting-type specialties.
- O. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- P. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Removal Devices: Connect controls, electrical power, factory-furnished accessories, and inlet, outlet, and vent piping to unit.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

### 3.5 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Grease removal devices.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled grease removal devices and their installation, including piping and electrical connections, and to assist in testing.
- B. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.7 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain grease removal devices. Refer to Division 01 Section "Demonstration and Training."

3.9 FLOOR DRAIN SCHEDULE

- A. See the Plumbing Fixture Schedule on the drawings.

END OF SECTION 221320

## **SECTION 223100 - DOMESTIC WATER SOFTENERS**

### 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 commercial water softeners.
  - 1. Chemicals.
  - 2. Water testing kits.

#### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. PE: Polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Water Softeners. Include rated capacities, operating characteristics, furnished specialties, and accessories.
  - 2. Water testing kits.
- B. Shop Drawings: For water softeners. Include plans, elevations, sections, details, and connections to piping systems.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that indicated steel mineral tanks, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

- a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
  - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Manufacturer Certificates: Signed by manufacturers certifying that water softeners comply with requirements.
- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For water softeners to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.
- I. Maintenance service agreement.

#### 1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water softeners and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. ASME Compliance for Steel Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, where indicated.
- D. ASME Compliance for FRP Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, where indicated.

#### 1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.



## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water softener that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Structural failures of mineral and brine tanks.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
    - d. Attrition loss of resin exceeding 3 percent per year.
    - e. Mineral washed out of system during service run or backwashing period.
    - f. Effluent turbidity greater and color darker than incoming water.
    - g. Fouling of underdrain system, gravel, and resin, with turbidity or by dirt, rust, or scale from softener equipment or soft water, while operating according to manufacturer's written operating instructions.
  2. Commercial Water Softener, Warranty Period: From date of Substantial Completion.
    - a. Mineral Tanks: 10 years.
    - b. Brine Tanks: Five years.
    - c. Controls: 10 years.
    - d. Underdrain Systems: Five years.

## 1.8 MAINTENANCE SERVICE

- A. Maintenance: Submit four copies of manufacturer's "Agreement for Continued Service and Maintenance," before Substantial Completion, for Owner's acceptance. Offer terms and conditions for furnishing chemicals and providing continued testing and servicing to include replacing materials and equipment. Include one-year term of agreement with option for one-year renewal.

## 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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 COMMERCIAL WATER SOFTENERS

- A. Description: Factory-assembled, pressure-type water softener.

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

1. Manufacturers:
  - a. NUVO
2. Comply with NSF 61, "Drinking Water System Components--Health Effects."
3. Configuration: Twin unit with two mineral tanks and one brine tank, factory mounted on skid.
4. Mineral Tanks: Steel, electric welded; pressure-vessel quality.
  - a. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
  - b. Construction: Fabricated and stamped to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels."
  - c. Pressure Rating 125 psig > minimum.
  - d. Wetted Components: Suitable for water temperatures from 40 to at least 100 deg F.
  - e. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
  - f. Handholes: 4 inches round or 4 by 6 inches elliptical, in top head and lower sidewall of tanks 30 inches and smaller in diameter.
  - g. Manhole: 11 by 15 inches in top head of tanks larger than 30 inches in diameter.
  - h. Support Legs or Skirt: Constructed of structural steel, welded to tank before testing and labeling.
  - i. Finish: Hot-dip galvanized on exterior and interior of tank after fabrication unless tank is stainless steel.
  - j. Finish: Exterior of tank spray painted with rust-resistant prime coat, 2- to 3-mil dry film thickness. Interior sandblasted and lined with epoxy-polyamide coating, 8- to 10-mil dry film thickness.
  - k. Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.
  - l. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from PVC pipe and fittings with individual, fine-slotted, nonclogging PE strainers; arranged for even flow distribution through resin bed.
  - m. Liner: PE, ABS, or other material suitable for potable water.
5. Controls: Fully automatic; factory mounted on unit and factory wired.
  - a. Adjustable duration of various regeneration steps.
  - b. Push-button start and complete manual operation.
  - c. Electric time clock and switch for fully automatic operation, adjustable to initiate regeneration at any hour of day and any day of week or at fixed intervals.

- d. Sequence of Operation: Program multiport pilot-control valve to automatically pressure-actuate main operating valve through steps of regeneration and return to service.
- e. Pointer on pilot-control valve shall indicate cycle of operation.
- f. Means of manual operation of pilot-control valve if power fails.
- g. Main Operating Valves: Industrial, automatic, multiport, diaphragm type with the following features:
  - 1) Slow opening and closing, nonslam operation.
  - 2) Diaphragm guiding on full perimeter from fully open to fully closed.
  - 3) Isolated dissimilar metals within valve.
  - 4) Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.
  - 5) Valve for single mineral-tank unit with internal automatic bypass of raw water during regeneration.
  - 6) Sampling cocks for soft water.
  - 7) Special tools are not required for service.
- h. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressures, and that does not require field adjustments.
  - 1) Meter Control: Equip each mineral tank with signal-register-head water meter that will produce electrical signal indicating need for regeneration on reaching hand-set total in gallons. Design so signal will continue until reset.
  - 2) Demand-Initiated Control: Equip single mineral-tank units with automatic-reset-head water meter that electrically activates cycle controller to initiate regeneration at preset total in gallons. Design so head automatically resets to preset total in gallons for next service run.
  - 3) Demand-Initiated Control: Equip each mineral tank of twin mineral-tank units with automatic-reset-head water meters that electrically activate cycle controllers to initiate regeneration at preset total in gallons. Design so heads automatically reset to preset total in gallons for next service run. Include electrical lockout to prevent simultaneous regeneration of both tanks.
  - 4) Demand-Initiated Control: Equip each mineral tank of twin mineral-tank units with automatic-reset-head water meter in common outlet header that electrically activates cycle controller to automatically regenerate one mineral tank at preset total in gallons and divert flow to other tank. Set to repeat with other tank. Include electrical lockout to prevent simultaneous regeneration of both tanks.
  - 5) Demand-Initiated Control: Equip each mineral tank of multiple mineral-tank units with automatic-reset-head water meters that electrically activate cycle controllers to automatically regenerate at preset total in gallons. Design so heads automatically reset to preset total in gallons for next service run. Include electrical lockouts to prevent simultaneous regeneration of more than one tank.
  - 6) Demand-Initiated Control: Equip each mineral tank of multiple mineral-tank units with automatic-reset-head water meter in common outlet header that electrically activates cycle controller to automatically regenerate one mineral tank at preset total in gallons and divert flow to other tanks. Set to

repeat with other tanks. Include electrical lockouts to prevent simultaneous regeneration of more than one tank.

6. Factory-Installed Accessories:
  - a. Piping, valves, tubing, and drains.
  - b. Sampling cocks.
  - c. Main-operating-valve position indicators.
  - d. Water meters.

### 2.3 WATER TESTING SETS

- A. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

### 2.4 SOURCE QUALITY CONTROL

- A. Hydrostatically test mineral tanks before shipment to minimum of one and one-half times pressure rating.
- B. Prepare test

reports. PART 3 -

## EXECUTION

### 3.1 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for commercial water softeners. Refer to Division 22 Section "Common Work Results for Plumbing."
  1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
  2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevation required for proper attachment to supported equipment.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

### 3.2 WATER SOFTENER INSTALLATION

- A. Install commercial water softener equipment on concrete bases, level and plumb.

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor mineral and brine tanks and floor-mounting accessories to substrate.

- B. Install seismic restraints for tanks and floor-mounting accessories and anchor to building structure.
- C. Install brine lines and fittings furnished by equipment manufacturer but not specified to be factory installed.
- D. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.
- E. Install water testing sets mounted on wall, unless otherwise indicated, and near water softeners.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Make piping connections between water-softener-unit headers and dissimilar-metal water piping with dielectric fittings. Dielectric fittings are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Install shutoff valves on raw-water inlet and soft-water outlet piping of each mineral tank, and on inlet and outlet headers.
  - 1. Metal general-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
  - 2. Plastic valves are specified in Division 22 Section "Domestic Water Piping."
  - 3. Exception: Water softeners with factory-installed shutoff valves at locations indicated.
- E. Install pressure gages on raw-water inlet and soft-water outlet piping of each mineral tank.

Pressure gages are specified in Division 22 Section "Meters and Gages for Plumbing Piping."

  - 1. Exception: Water softeners with factory-installed pressure gages at locations indicated.
  - 2. Exception: Water softeners in hot-water service.
- F. Install valved bypass water piping around water softeners.
  - 1. Metal general-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
  - 2. Water piping is specified in Division 22 Section "Domestic Water Piping."
  - 3. Exception: Household water softeners.
  - 4. Exception: Water softeners in hot-water service.
- G. Install drains as indirect wastes to spill into open drains or over floor drains.

- H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning water softeners that do not pass tests and inspections and retest as specified above.

### 3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
- B. Add water to brine tanks and fill with salt.
  - 1. Commercial Water Softeners: Food-grade salt pellets.
- C. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:
  - 1. ASTM D 859, "Test Method for Silica in Water."
  - 2. ASTM D 1067, "Test Methods for Acidity or Alkalinity of Water."
  - 3. ASTM D 1068, "Test Methods for Iron in Water."
  - 4. ASTM D 1126, "Test Method for Hardness in Water."
  - 5. ASTM D 1129, "Terminology Relating to Water."
  - 6. ASTM D 3370, "Practices for Sampling Water from Closed Conduits."

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

to adjust, operate, and maintain water softeners. Refer to Division 01 "Demonstration and Training" Section

END OF SECTION 223100

## **SECTION 22 33 00 - ELECTRIC DOMESTIC WATER HEATERS**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION:**

- A. This section describes the requirements for installing a complete electric domestic water heater system ready for operation including the water heaters, thermometers, and all necessary accessories, connections, and equipment.

#### **1.2 RELATED WORK:**

- A. Section 09 91 00, PAINTING: Preparation and finish painting.
- B. Section 22 05 00, COMMON WORK RESULTS FOR PLUMBING.
- C. Section 22 11 23, DOMESTIC WATER PUMPS: Circulating Pumps.
- D. Section 22 07 00, PLUMBING INSULATION
- E. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING, 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING.
- F. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraint for Equipment.

#### **1.3 QUALITY ASSURANCE:**

- A. Comply with American Society of Heating, Refrigerating and Air- Conditioning Engineers (ASHRAE) for efficiency performance:
  - 1. ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings, "for commercial water heaters."



Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

- B. Electrical components, devices and accessories shall be listed and labeled B as defined in NFPA 70 by a qualified testing agency, and marked for intended location and application.
- C. ASME code construction shall be a vessel fabricated in compliance with the ASME boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, “Drinking Water System Components – Health Effects”
- E. The electric domestic water heater shall conform to Section 13 05 41 on Seismic restraint requirements, withstanding Seismic movement without separation of any parts from the equipment when subjected to a Seismic event.

1.4 SUBMITTALS:

- A. Submit manufacturer’s literature and data pertaining to the water heater in properly bound package, in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Include the following as a minimum:
  - 1. Water Heaters.
  - 2. Pressure and Temperature Relief Valves.
  - 4. Thermometers.
  - 5. Pressure Gages.
  - 6. Vacuum Breakers.
- B. For each electric domestic hot water heater type and size, the following characteristics shall be submitted:
  - 1. Rated Capacities.
  - 2. Operating characteristics.
  - 3. Electrical characteristics.
  - 4. Furnished specialties and accessories.
  - 5. A form U-1 or other documentation stating compliance with the ASME Boiler and Pressure Vessel code.
- C. Shop drawings shall include wiring diagrams for power, signal and control functions.

- D. Seismic qualification certificates shall be submitted that details equipment anchorage components, identifies equipment center of gravity with mounting and anchorage provisions, and whether the seismic qualification certificate is based on an actual test or calculations.
- E. The domestic water heater shall be certified and labeled by a testing agency.

1.5 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Sanitary Engineering (ASSE):
  - 1005.....Performance Requirements for Water Heater Drain Valves, 20 mm (3/4 inch) size
- C. American National Standard Institute (ANSI):
  - Z21.22B-2001 .....Relief Valves for Hot Water Supply Systems
- D. American Society of Mechanical Engineers (ASME):
  - B1.20.1-83(R 2006).....Pipe Threads, General Purpose (Inch)
  - B16.5-03.....Standard for Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24
  - B16.24-06.....Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500, and 2500.
  - PTC 25.3-02 .....Pressure Relief Devices
  - Section IV-07 .....Boiler and Pressure Vessel Code; Section IV, Recommended Rules for the Care and Operation of Heating Boilers
  - Section VIII D1-07.....Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels Division 1 –Basic Coverage
- E. National Fire Protection Association (NFPA)
  - 70-06 .....National Electrical Code
- F. Underwriters Laboratories, Inc. (UL):

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

174-04 .....Household Electric Storage Tank Water Heaters  
1453-04 .....Water Heaters, Electric Booster and Commercial Storage Tank  
499-05 .....Standard for Safety Electric Heating Appliances

1.6 AS-BUILT DOCUMENTATION

- A. The electronic documentation and copies of the Operations and Maintenance Manual, approved submittals, shop drawings, and other closeout documentation shall be prepared by a computer software program complying with Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C 794d). The manufacturer or vendor of the software used to prepare the electronic documentation shall have a Voluntary Product Accessibility Template made available for review and included as part of the Operations and Maintenance Manual or closeout documentation. All available accessibility functions listed in the Voluntary Accessibility Template shall be enabled in the prepared electronic files. As Adobe Acrobat is a common industry format for such documentation, following the document, "Creating Accessible Adobe PDF files, A Guide for Document Authors" that is maintained and made available by Adobe free of charge is recommended.”
- B. Four sets of manufacturer’s literature and data updated to include submittal review comments and any equipment substitutions.
- C. Four sets of operation and maintenance data updated to include submittal review comments shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

## PART 2 - PRODUCTS

### 2.1 ELECTRIC DOMESTIC WATER HEATERS:

- A. Water Heater to be tankless Bosch Tronic 3000 US12 or equal model to be approved by owner.
- B. Tank insulation shall comply with ASHRAE 90.1.
- C. For domestic hot water heater sizes greater than 9 KW, the heating element shall be arranged in multiples of three elements. For heaters less than 9 KW, the heater elements shall be arranged in double elements.
- D. The domestic hot water heaters shall have screw in or bolt in immersion type, thermostatically adjustable. Set thermostat for maximum water temperature of 55°C (130°F). The electrical characteristics are scheduled on the drawings.
- E. Combination Pressure and Temperature Relief Valves shall be ASME rated and stamped for combination temperature and pressure relief valves. One or more relief valves with total relieving capacity at least as great as the heat input shall be included. The pressure setting shall be less than the domestic water heater working pressure rating.
- F. the anode rod shall be replaceable magnesium.
- G. the drain valve shall be corrosion resistant metal complying with ASSE 1005.

### 2.2 ELECTRIC, TANKLESS, DOMESTIC WATER HEATER

- A. The tappings shall be factory fabricated steel, welded to the tank and include ASME B1.20.1 pipe thread.
- B. The interior finish shall comply with NSF 61 barrier materials for potable water tank linings and the liner shall extend into and through the tank fittings and outlets.
- C. The air charging valve shall be factory installed.

2.3 DOMESTIC HOT WATER COMPRESSION TANKS (NOT USED)

2.4 ELEVATED ELECTRIC WATER HEATER DRAIN PAN

- A. A stainless steel drain pan shall be provided that is large enough to contain the volume of the heater. The drain pan shall include a drain outlet not less than 20 millimeter or DN 20 (NPS ¾") with ASME B1.20.7 garden hose threads.

2.5 HEAT TRAPS

- A. Heat traps shall be installed in accordance with ASHRAE 90.1, latest edition.

2.6 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES

- A. The combination temperature and pressure relief valves shall be ASME rated and stamped and include a relieving capacity at least as great as the heat input and include a pressure setting less than the water heater's working pressure rating.

2.7 THERMOMETERS:

- A. The thermometers shall be straight stem, iron case, red reflecting mercury thermometer or red liquid-filled thermometers, approximately 175 mm (7 inches) high, 4 to 115°C (40 to 240°F).

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Water heaters shall be installed on concrete bases unless elevated above the floor. Refer to Specification Section 03 30 00, CAST-IN-PLACE CONCRETE and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING
- B. The water heaters shall be installed level and plumb and securely anchored.

- C. The water heaters shall be installed and connected in accordance with manufacturer's written instructions.
- D. All pressure and temperature relief valves discharge shall be piped to nearby floor drains.
- E. Thermometers shall be installed on the water heater inlet and outlet piping.
- F. The thermostatic control shall be set for a maximum setting of 54 degrees C (130 degrees F).
- G. Shutoff valves shall be installed on the domestic water supply piping to the water heater and on the domestic hot water outlet piping.
- H. All manufacturers's required clearances shall be maintained.
- I. The electric domestic water heaters shall be installed with seismic restraint devices.
- J. A combination temperature and pressure relief valve shall be installed at the top portion of the storage tank. The sensing element shall extend into the tank. The relief valve outlet drain piping shall discharge by positive air gap into a floor drain.
- K. Piping type heat traps shall be installed on the inlet and outlet piping of the electric domestic hot water heater storage tanks.
- L. Water heater drain piping shall be installed as indirect waste to spill by positive air gap into open drains or over floor drains. Hose end drain valves shall be installed at low points in water piping for electric domestic hot water heaters without integral drains.

### 3.2 LEAKAGE TEST:

- A. Before piping connections are made, water heaters shall be tested with hydrostatic pressure of 1375 kPa (200 psi) and 1654 kPa (240 psi) for a unit with a MAWP of 1103 kPa (160 psi). Any domestic water heater leaking water shall be replaced with a new unit at no additional cost to the Owner.

3.3 PERFORMANCE TEST:

- A. All of the remote water outlets shall have a minimum of 49°C (120°F) and a maximum of 54°C (130°F) water flow at all times. If necessary, make all corrections to balance the return water system or reset the thermostat to make the system comply with design requirements.

END OF SECTION 22 33 00

## SECTION 224000 - PLUMBING FIXTURES

### 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 conventional plumbing fixtures and related components:

1. Faucets for lavatories, showers and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective ADA shielding guards.
5. Fixture supports.
6. Water closets.
7. Waterless urinals.
8. Lavatories.
9. Commercial sinks.
10. Kitchen sinks.
11. Service sinks.
12. Kitchen equipment.

- B. Related Sections include the following:

1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Drinking Fountains and Water Coolers."

#### 1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- C. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.



- D. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- E. FRP: Fiberglass-reinforced plastic.
- F. PMMA: Polymethyl methacrylate (acrylic) plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
  - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
  - 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
  - 4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
  - 5. Stainless-Steel Residential Sinks: ASME A112.19.3.
  - 6. Vitreous-China Fixtures: ASME A112.19.2M.
  - 7. Water-Closet, Flushometer Tank Trim: ASSE 1037.
  - 8. Whirlpool Bathtub Fittings: ASME A112.19.8M.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
  - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
  - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
  - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
  - 4. Faucets: ASME A112.18.1.
  - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
  - 6. Hose-Coupling Threads: ASME B1.20.7.
  - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  - 8. NSF Potable-Water Materials: NSF 61.
  - 9. Pipe Threads: ASME B1.20.1.
  - 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
  - 11. Supply Fittings: ASME A112.18.1.
  - 12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for bathtub/shower and shower faucets:
  - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
  - 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
  - 3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
  - 4. Faucets: ASME A112.18.1.
  - 5. Hand-Held Showers: ASSE 1014.
  - 6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
  - 7. Hose-Coupling Threads: ASME B1.20.7.
  - 8. Manual-Control Antiscald Faucets: ASTM F 444.
  - 9. Pipe Threads: ASME B1.20.1.
  - 10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Off-Floor Fixture Supports: ASME A112.6.1M.
8. Pipe Threads: ASME B1.20.1.
9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.

## 1.6 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.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Toilet Seats: Equal to 5 percent of amount of each type installed.

## PART 2 - PRODUCTS

### 2.1 LAVATORY FAUCETS

#### A. Lavatory Faucets:

1. Basis of Design: See the plumbing fixture schedule on the drawings.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Chicago Faucets.
  - b. T & S Brass and Bronze Works, Inc.
  - c. Moen, Inc.
  - d. Zurn

#### B. Sensor Lavatory Faucets:

1. Basis of Design: See the plumbing fixture schedule on the drawings.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Chicago Faucets.
  - b. Sloan
  - c. Zurn

### 2.2 FLUSHOMETERS

#### A. Flushometers:

1. Basis of Design: See the plumbing fixture schedule on the drawings.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Sloan Valve Company.
  - b. Zurn Plumbing Products Group; Commercial Brass Operation.

#### B. Sensor Flushometers:

1. Basis of Design: See the plumbing fixture schedule on the drawings.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Sloan Valve Company.

- b. Zurn Plumbing Products Group; Commercial Brass Operation.

## 2.3 TOILET SEATS

### A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bemis Manufacturing Company.
  - b. Centoco Manufacturing Corp.
  - c. Church Seats.
  - d. Olsonite Corp.
  - e. Sperzel.
  - f. American Standard.
2. Description: Toilet seat for water-closet-type fixture.
  - a. Material: Molded, solid plastic with antimicrobial agent.
  - b. Configuration: Open front without cover.
  - c. Size: Elongated.
  - d. Hinge Type: CK, check.
  - e. Class: Heavy-duty commercial.
  - f. Color: White.

## 2.4 PROTECTIVE ADA SHIELDING GUARDS

### A. Protective ADA Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Engineered Brass Co.
  - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
  - c. McGuire Manufacturing Co., Inc.
  - d. Plumberex Specialty Products Inc.
  - e. TCI Products.
  - f. TRUEBRO, Inc.
  - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold- water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements. Product shall also meet the ASTM E 84 25/450 smoke and flame rating.

### B. Protective ADA Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. TRUEBRO, Inc.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## 2.5 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

- B. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

- C. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

## 2.6 WATER CLOSETS

- A. Water Closets:

1. Basis of Design; See the plumbing fixture schedule on the drawings.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard Companies, Inc.
  - b. Crane Plumbing, L.L.C./Fiat Products.
  - c. Eljer.
  - d. Kohler Co.

## 2.7 WATERLESS URINALS (NOT USED)

## 2.8 LAVATORIES

### A. Lavatories:

1. Basis of Design: See the plumbing fixture schedule on the drawings.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard Companies, Inc.
  - b. Briggs Plumbing Products, Inc.
  - c. Crane Plumbing, L.L.C./Fiat Products.
  - d. Eljer.
  - e. Kohler Co.
  - f. Zurn

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
  1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install counter-mounting fixtures in and attached to casework.

- G. Install fixtures level and plumb according to roughing-in drawings.
- H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- L. Install toilet seats on water closets.
- M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- Q. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- R. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- S. Set bathtubs and service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- T. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."



- U. All plumbing fixtures are to be mounted at the height specified on the Architectural drawings.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. Install fresh batteries in sensor-operated mechanisms.

### 3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

Window Rock Office Building and Site  
CONSTRUCTION DOCUMENTS

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

3.8 PLUMBING FIXTURE SCHEDULE (see the plumbing fixture schedules on the drawings)

END OF SECTION 224000

## SECTION 224700 - DRINKING FOUNTAINS AND WATER COOLERS

### 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 drinking fountains and water coolers and related components:
  - 1. Drinking fountains.
  - 2. Fixture supports.

#### 1.3 DEFINITIONS

- A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Cast Polymer: Dense, cast-filled-polymer plastic.
- C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- D. Fitting: Device that controls flow of water into or out of fixture.
- E. Fixture: Drinking fountain or water cooler unless one is specifically indicated.
- F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.
- G. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

#### 1.4 SUBMITTALS

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act" ; and Public Law 101-336, "Americans with Disabilities Act" ; for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.
- E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

## PART 2 - PRODUCTS

### 2.1 DRINKING FOUNTAINS

- A. Drinking Fountains:
  - 1. Basis of Design: See plumbing fixture schedules on the drawings.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Acorn Aqua.
    - b. Elkay.
    - c. Halsey Taylor.
    - d. Haws Corporation.
    - e. Sunroc/Oasis

### 2.2 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Josam Co.

2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Set freestanding and pedestal drinking fountains on floor.
- D. Set remote water coolers on floor, unless otherwise indicated.
- E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

#### 3.3 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

- C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.5 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
  - 1. Remove and replace malfunctioning units and retest as specified above.
  - 2. Report test results in writing.

### 3.6 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

3.7 CLEANING

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

END OF SECTION 224700

## **SECTION 230100 - MECHANICAL REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1 GENERAL CONDITIONS**

- A. The General Conditions of the Contract, with the amendments, supplements, forms and requirements in Division 1, and herewith made a part of this Division.
- B. All sections of Division 22, & 23 shall comply with the Mechanical General Requirements. The standards established in this section as to quality of materials and equipment, the type and quality of workmanship, mode of operations, safety rules, code requirements, etc., shall apply to all sections of this Division as though they were repeated in each Division.
- C. Mechanical equipment that is pre-purchased if any will be assigned to the Mechanical Contractor. By assignment to the Mechanical Contractor, the Mechanical Contractor shall accept and install the equipment and provide all warranties and guarantees as if the Mechanical Contractor had purchased the equipment.
- D. Construction Indoor-Air Quality Management

Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

- 1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
- 2. Replace all air filters immediately prior to occupancy.

#### **1.2 SCOPE OF WORK**

- A. This work shall include all labor, materials, equipment, fixtures, and devices for the entire mechanical work and a complete operating and tested installation as required for this project.
- B. This Division will schedule the boiler inspection and pay for all costs associated with certifying the boiler with the state.

#### **1.3 CODES & ORDINANCES**

- A. All work shall be executed in accordance with all underwriters, public utilities, local and state rules and regulations applicable to the trade affected. Should any change in the plans and



Specifications be required to comply with these regulations, the Contractor shall notify the Architect before the time of submitting his bid. After entering into contract, the Contractor will be held to complete all work necessary to meet these requirements without extra expense to the Owner. Where work required by drawings or specifications is above the standard required, it shall be done as shown or specified.

B. Applicable codes:

International Building code - 2009 Edition  
International Mechanical Code - 2009 Edition  
International Plumbing Code - 2009 Edition  
International Fire Code - 2009 Edition

1.4 INDUSTRY STANDARDS

A. All work shall comply with the following standards.

1. Associated Air Balance council (AABC)
2. Air Conditioning and Refrigeration Institute (ARI)
3. Air Diffusion council (ADC)
4. Air Movement and Control Association (AMCA)
5. American Gas Association (AGA)
6. American National Standards Institute (ANSI)
7. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
8. American Society of Mechanical Engineers (ASME)
9. American Society of Testing Materials (ASTM)
10. American Water Works Association (AWWA)
11. Cooling Tower Institute (CTI)
12. ETL Testing Laboratories (ETL)
13. Institute of Electrical and Electronic Engineers (IEEE)
14. Hydronics Institute (HI)
15. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
16. National Fire Protection Association (NFPA)
17. National Electrical Code (NEC)
18. National Electrical Manufacturers Association (NEMA)
19. National Electrical Safety code (NESC)
20. Utah safety Standard (OSHA), Utah State Industrial Council.
21. Sheet Metal and Air Conditioning Contractor=s National Association (SMACNA)
22. Underwriters Laboratories (UL)
23. Tubular Exchanger Manufacturers Association, Inc. (TEMA)
24. Heat Exchanger Institute (HEI)
25. Hydraulic Institute (HI)
26. Thermal Insulation Manufacturers Association (TIMA)
27. Scientific Apparatus Makers Association (SAMA)

B. Compliance Verification:

28. All items required by code or specified to conform to the ASME code shall be stamped with the ASME seal.
29. Form U-1, the manufacturer's data report for pressure vessels, is to be included in the Operation and Maintenance Manuals. National Board Register (NBR) numbers shall be provided where required by code.
30. Manufactured equipment which is represented by a UL classification and/or listing, shall bear the UL or equivalent ETL label.

#### 1.5 UTILITIES & FEES

- A. All fees for permits required by this work will be paid by this division. The contractor shall obtain the necessary permits to perform this work. Unless noted otherwise, all systems furnished and or installed by this Contractor, shall be complete with all utilities, components, commodities and accessories required for a fully functioning system. This Contractor shall furnish smoke generators when required for testing, furnish glycol for glycol piping systems, full load of salt to fill brine tank for water softening system, furnish cleaners and water treatment additives.

#### 1.6 SUBMITTALS AND SHOP DRAWINGS

- A. Submittals: As soon as possible after the contract is awarded, but in no case more than 45 calendar days thereafter, the Contractor shall submit to the Architect six (6) copies of the descriptive literature covering products and materials to be used in the installation of mechanical systems for this project. The review of the submitted data will require a minimum of 14 days. The first day starts after the day they are received in the engineers office to which the project is being constructed from. If the Contractors schedule requires return of submitted literature in less than the allotted time, the Contractor shall accelerate his submittal delivery date. The Contractor shall resubmit all items requiring re-review within 14 days of returned submittals. Refer to each specification section for items requiring submittal review. Written approval of the Owner's Representative shall be obtained before installing any such equipment or materials for the project. The submittals shall be prepared in an orderly manner, contained in a 3-ring loose-leaf binder with index and identification tabs each item or group of items and for each specification section. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within 120 days of the contract award date. Partial submittals will not be reviewed until the complete submittal is received.
- B. Submitted literature shall bear the Contractor's stamp, indicating that he has checked all equipment being submitted; that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.
- C. Submitted literature shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation.

Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired equipment shall include shop drawings for all internal wiring and piping furnished with the unit.

- D. Submitted literature shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.
- E. Review by the Owner's Representative is for general conformance of the submitted equipment to the project specification. In no way does such review relieve this Contractor of his obligation to furnish equipment and materials that comply in detail to the specification nor does it relieve the Contractor of his obligation to determine actual field dimensions and conditions that may affect his work. Regardless of any items overlooked by the submittal review, the requirements of the contract drawings and specifications must be followed and are not waived or superseded in any way by the review.
- F. By description, catalog number, and manufacturer's names, standards of quality have been established by the Architect and the Engineer for certain manufactured equipment items and specialties that are to be furnished by this Division. Alternate products and equipment may be proposed for use only if specifically named in the specifications or if given written prior approval in published addenda. Design equipment is the equipment listed on the drawings or if not listed on the drawings is the equipment first named in the specifications.
- G. If the Engineer is required to do additional design work to incorporate changes caused by submitting equipment or products, different than the design equipment specified, as defined above, the contractor shall reimburse the engineer for additional time and expenses at the engineer's current, recognized, hourly rates.

## 1.7 DRAWINGS AND MEASUREMENTS

- A. Construction Drawings: The contract document drawings show the general design, arrangements, and extent of the system. In certain cases, the drawings may include details that show more nearly exact locations and arrangements; however, the locations, as shown diagrammatically, are to be regarded as general.
- H. It shall be the work of this Section to make such slight alterations as may be necessary to make adjustable parts fit to fixed parts, leaving all complete and in proper shape when done. All dimensions given on the drawings shall be verified as related to this work and with the Architect's office before work is started.
- I. This Section shall carefully study building sections, space, clearances, etc., and then provide offsets in piping or ductwork as required to accommodate the building structure without additional cost to the Owner. In any case and at any time during the construction process, a change in location required by obstacles or the installation of other trades not shown on the mechanical plans shall be made without charge.
- J. The drawings shall not be scaled for roughing in measurements nor shall they be used as shop drawings. Where drawings are required for these purposes or where drawings must be

- made from field measurements, the Contractor shall take the necessary measurements and prepare the drawings. Shop drawings of the various subcontractors shall be coordinated to eliminate all interferences and to provide sufficient space for the installation of all equipment, piping, ductwork, etc.
- K. The drawings and specifications have been prepared to supplement each other and they shall be interpreted as an integral unit with items shown on one and not the other being furnished and installed as though shown and called out on both.
- L. Coordination Drawings: The contractor shall provide coordination drawings for mechanical rooms, fan rooms, equipment rooms, and congested areas to eliminate conflicts with equipment, piping, or work of other trades. The drawings shall be a minimum scale of 1/4 inch= 1 foot and of such detail as may be required by the Engineer to fully illustrate the work. These drawings shall include all piping, conduit, valves, equipment, and ductwork.
- M. Sheet-metal shop drawings will be required for all ductwork in the entire building. These drawings will show all ductwork in the entire building and shall be coordinated with architectural, structural and electrical portions of the project. The contractor shall specifically obtain copies of the structural shop drawings and shall coordinate the ductwork shop drawings with approved structural members. These drawings shall be submitted to the engineer for review prior to any fabrication. The contractor is responsible for all modifications necessary to accommodate duct installation within the structural, architectural and electrical restrictions. These drawings, once reviewed by the engineer, will be made available to all mechanical, electrical, and fire sprinkler subcontractors to coordinate installation of their work.

#### 1.8 CONTRACTOR'S USE OF BUILDING EQUIPMENT

- A. The Contractor may use equipment such as electric motors, fans, heat exchangers, filters, etc., with the written permission of the Owner. As each piece of equipment is used (such as electric motors and fans), maintenance procedures approved by the manufacturer are to be followed. A careful record is to be kept of the length of the time the equipment is used, maintenance procedures followed, and any difficulty encountered. The record is to be submitted to the Owner upon acceptance. All fan belts and filter media (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement. New filter media shall be installed in air handlers at the time systems are turned over to the owner.

#### 1.9 EXISTING CONDITIONS

- A. The Contractor shall carefully examine all existing conditions that might affect the mechanical system and shall compare these conditions with all drawings and specifications for work included under this contract. He shall, at such time, ascertain and check all conditions that may affect his work. No allowance shall subsequently be made in his behalf for an extra expense incurred as a result of his failure or neglect to make such examination. This Contractor shall include in his bid proposal all necessary allowances to repair or replace any item that will remain or will be removed, and any item that will be damaged or destroyed by new construction.

- B. The Contractor shall remove all abandoned piping, etc., required by new construction and cap or plug openings. No capping, etc., shall be exposed in occupied areas. All openings of items removed shall be sealed to match adjacent surfaces.
- C. The Contractor shall verify the exact location of all existing services, utilities, piping, etc., and make connections to existing systems as required or as shown on the drawings. The exact location of each utility line, together with size and elevation, shall be established before any on-site lines are installed. Should elevation or size of existing main utility lines make connections to them impossible as shown on drawings, then notification of such shall immediately be given to the Owners Representative for a decision.

#### 1.10 EQUIPMENT CAPACITIES

- A. Capacities shown for equipment in the specifications and on the drawings are the minimum acceptable. No equipment shall be considered as an alternate that has capacities or performance less than that of design equipment.
- B. All equipment shall give the specified capacity and performance at the job-site elevation. Manufacturers' standard ratings shall be adjusted accordingly. All capacities and performances listed on drawings or in specifications are for job-site conditions.

#### 1.11 SEISMIC REQUIREMENTS FOR EQUIPMENT

- A. All equipment shall be furnished structurally adequate to withstand seismic forces as outlined in the International Building Code. Refer to section Mechanical Vibration Controls and Seismic Restraints. Equipment bases shall be designed for direct attachment of seismic snubbers and/or seismic anchors.

#### 1.12 COOPERATION WITH OTHER TRADES

- A. The Contractor shall refer to other drawings and parts of this specification that cover work of other trades that is carried on in conjunction with the mechanical work such that all work can proceed without interference resulting from lack of coordination.
- B. The Contractor shall properly size and locate all openings, chases, sleeves, equipment bases, and accesses. He shall provide accurate wiring diagrams to the Electrical Contractor for all equipment furnished under this Division.
- C. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing, waste, and soil lines; supply, return, and exhaust ductwork; water piping; medical gases; fire protection piping; and pneumatic control piping.

- D. The mechanical Contractor shall insure that the installation of all piping, ducts and equipment is in compliance with Articles 110-16 and 384-4 of the National Electrical Code relative to proper clearances in front of and over all electrical panels and equipment. No piping or ductwork will be allowed to run over electrical panel.

#### 1.13 RESPONSIBILITY OF CONTRACTOR

- A. The Contractor is responsible for the installation of a satisfactory piece of work in accordance with the true intent of the drawings and specifications. He shall provide, as a part of his work and without expense, all incidental items required even though these items are not particularly specified or indicated. The installation shall be made so that its several component parts will function together as a workable system and shall be left with all equipment properly adjusted and in working order. The Contractor shall familiarize the Owner's Representative with maintenance and lubrication instructions as prepared by the Contractor and shall explain and fully instruct him relative to operating, servicing, and maintenance of them.
- B. If a conflict arises between the drawings and the specifications the most stringent procedure/action shall be followed. A clarification to the engineer will help to determine the course of action to be taken. If a conflict arises between specification sections the engineer will determine which course of action is to be followed.

#### 1.14 PIPE AND DUCT OPENINGS AND EQUIPMENT RECESSES

- A. Pipe and duct chases, openings, and equipment recesses shall be provided by others only if shown on architectural or structural drawings. All openings for the mechanical work, except where plans and specifications indicate otherwise, shall be provided as work of this Division. Include openings information with coordination drawings.
- B. Whether chases, recesses, and openings are provided as work of this Division or by others, this Contractor shall supervise their construction and be responsible for the correct size and location even though detailed and dimensioned on the drawings. This Contractor shall pay for all necessary cutting, repairing, and finishing if any are left out or incorrectly made. All necessary openings thru existing walls, ceilings, floors, roofs, etc. shall be provided by this Contractor unless indicated otherwise by the drawing and/or specifications.

#### 1.15 UNFIT OR DAMAGED WORK

- A. Any part of this installation that fails, is unfit, or becomes damaged during construction, shall be replaced or otherwise made good. The cost of such remedy shall be the responsibility of this Division.

#### 1.16 WORKMANSHIP

Window Rock Office Building and Site  
Construction Documents

- A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Owner's representative. Nothing contained herein shall relieve the Contractor from making good and perfect work in all details in construction.

1.17 SAFETY REGULATION

- A. The Contractor shall comply with all local, Federal, and OSHA safety requirements in performance with this work. (See General Conditions). This Contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

1.18 ELECTRICAL SERVICES

- A. All equipment control wiring and all automatic temperature control wiring including all necessary contacts, relays, and interlocks, whether low or line voltage, except power wiring, shall be furnished and installed as work of this Division. All such wiring shall be in conduit as required by electrical codes. Wiring in the mechanical rooms, fans rooms and inaccessible ceilings and walls shall be installed in conduit as well.
- N. All equipment that requires an electrical connection shall be furnished so that it will operate properly and deliver full capacity on the electrical service available.
- O. Refer to the electrical control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.
- P. The Mechanical Contractor must coordinate with the Electrical Contractor to insure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

1.19 WORK, MATERIALS, AND QUALITY OF EQUIPMENT

- A. Unless otherwise specified, all materials shall be new and of the best quality of their respective kinds and all labor shall be done in a most thorough and workmanlike manner.
- B. Products or equipment of any of the manufacturers cited herein or any of the products approved by the Addenda may be used. However, where lists of products are cited herein, the one first listed in the design equipment used in drawings and schedules to establish size, quality, function, and capacity standards. If other than design equipment is used, it shall be carefully checked for access to equipment, electrical and control requirements, valving, and piping. Should changes or additions occur in piping, valving, electrical work, etc., or if the work of other Contractors would be revised by the alternate equipment, the cost of all changes shall be borne as work of this Division.
- Q. The Execution portions of the specifications specify what products and materials may be used.

Any products listed in the Product section of the specification that are not listed in the Execution portion of the specification may not be used without written approval by the Engineer.

- R. The access to equipment shown on the drawings is the minimum acceptable space requirements. No equipment that reduces or restricts accessibility to this or any other equipment will be considered.
- S. All major items of equipment are specified in the equipment schedules on the drawings or in these specifications and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory installation.
- T. All welders shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, latest Edition.

#### 1.20 PROTECTION AGAINST WEATHER AND STORING OF MATERIALS

- A. All equipment and materials shall be properly stored and protected against moisture, dust, and wind. Coverings or other protection shall be used on all items that may be damaged or rusted or may have performance impaired by adverse weather or moisture conditions. Damage or defect developing before acceptance of the work shall be made good at the Contractor's expense.
- B. All open duct and pipe openings shall be adequately covered at all times.

#### 1.21 INSTALLATION CHECK

- A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedule and the seismic supplier shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Engineer.
- B. Each equipment supplier's representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it operated satisfactorily.
- C. All costs for this work shall be included in the prices quoted by equipment suppliers.



#### 1.22 EQUIPMENT LUBRICATION

- A. The Contractor shall properly lubricate all pieces of equipment before turning the building over to the Owner. A linen tag shall be attached to each piece of equipment, showing the date of lubrication and the lubricant used. No equipment shall be started until it is properly lubricated.
- B. Necessary time shall be spent with the Owner's Representative to thoroughly familiarize him with all necessary lubrications and maintenance that will be required of him.
- C. Detergent oil as used for automotive purposes shall not be used for this work.

#### 1.23 CUTTING AND PATCHING

- A. No cutting or drilling in structural members shall be done without written approval of the Architect. The work shall be carefully laid out in advance, and cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces necessary for the mechanical work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by professional plasterers, masons, concrete workers, etc., and all such work shall be paid for as work of this Division.
- B. When concrete, grading, etc., is disturbed, it shall be restored to original condition as described in the applicable Division of this Specification.

#### 1.24 EXCAVATION AND BACKFILLING

- A. All necessary excavations and backfilling for the Mechanical phase of this project shall be provided as work of this Division. Trenches for all underground pipelines shall be excavated to the required depths. The bottom of trenches shall be compacted hard and graded to obtain required fall. Backfill shall be placed in horizontal layers, not exceeding 12 inches in thickness, and properly moistened. Each layer shall be compacted, by suitable equipment, to a density of not less than 95 percent as determined by ASTM D-1557. After pipelines have been tested, inspected, and approved, the trench shall be backfilled with selected material. Excess earth shall be hauled from the job site. Fill materials approved by the Architect shall be provided as work of this Division.
- B. No trenches shall be cut near or under any footings without consultation first with the Architect's office. Any trenches or excavations more than 30 inches deep shall be tapered, shored, covered, or otherwise made absolutely safe so that no vehicle or persons can be injured by falling into such excavations, or in any way be harmed by cave-ins, shifting earth, rolling rocks, or by drowning. This protection shall be extended to all persons approaching excavation related to this work whether or not such persons are authorized to be in the vicinity of the construction.

#### 1.25 ACCESS

- A. Provide access doors in walls, ceilings and floors by this division unless otherwise noted. For access to mechanical equipment such as valves, dampers, VAV boxes, fans, controls, etc. Refer to Division 8 for door specifications. All access doors shall be 24" x 24" unless otherwise indicated or required. Coordinate location of doors with the Architect prior to installation. . If doors are not specified in Division 8, provide the following: Doors in ceilings and wall shall be equal to JR Smith No. 4760 bonderized and painted. Doors in tile walls shall be equal to JR Smith No. 4730 chrome plated. Doors in floors shall be equal to JR Smith No. 4910
- B. Valves: Valve must be installed in locations where access is readily available. If access is compromised, as judged by the Mechanical Engineer, these valves shall be relocated where directed at the Contractors expense.
- C. Equipment: Equipment must be installed in locations and orientations so that access to all components requiring service or maintenance will not be compromised. If access is compromised, as judged by the Mechanical Engineer, the contractor shall modify the installation as directed by the Engineer at the Contractors expense.
- D. It is the responsibility of this division to install terminal boxes, valves and all other equipment and devices so they can be accessed. If any equipment or devices are installed so they cannot be accessed on a ladder a catwalk and ladder system shall be installed above the ceiling to access and service this equipment.

#### 1.26 CONCRETE BASES AND INSERTS

- A. Bases: The concrete bases shall be provided and installed as work by this division. This Division shall be responsible for the proper size and location of bases and shall furnish all required anchor bolts and sleeves with templates to be installed as work of Division 3, Concrete.

All floor-mounted mechanical equipment shall be set on 6-inch high concrete bases, unless otherwise noted or shown on drawings. Such bases shall extend 6 inches beyond equipment or mounting rails on all sides or as shown on the drawings and shall have a 1-inch beveled edge all around.

- B. Inserts: Where slotted or other types of inserts required for this work are to be cast into concrete, they shall be furnished as work of this Division

Concrete inserts and pipe support systems shall be equal to Unistrut P3200 series for all piping where more than one pipe is suspended at a common location. Spacing of the inserts shall match the size and type of pipe and of ductwork being supported. The Unistrut insert and pipe support system shall include all inserts, vertical supports, horizontal support members, clamps, hangers, rollers, bolts, nuts, and any other accessory items for a complete pipe-supporting system.

## 1.27 CLEANING AND PAINTING

- A. **Cleaning:** After all tests and adjustments have been made and all systems pronounced satisfactory for permanent operation, this Contractor shall clean all exposed piping, ductwork, insulated members, fixture, and equipment installed under this Section and leave them ready for painting. He shall refinish any damaged finish and leave everything in proper working order. The Contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by his workman or for which he is responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.
- B. **Painting:** Painting of exposed pipe, insulated pipe, ducts, or equipment is work of Division 9, Painting.

**Mechanical Contractor:** All equipment which is to be furnished in factory prefinished conditions by the mechanical Contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.

- C. **Removal of Debris, Etc:** Upon completion of this division of the work, remove all surplus material and rubbish resulting from this work, and leave the premises in a clean and orderly condition.

## 1.28 CONTRACT COMPLETION

- A. **Incomplete and Unacceptable Work:** If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.
- B. **Maintenance Instructions:** The Contractor shall furnish the Owner complete printed and illustrated operating and maintenance instructions covering all units of mechanical equipment, together with parts lists.
- C. **Instructions To Owner's Representatives:** In addition to any detailed instructions called for, the mechanical Contractor must provide, without expense to the Owner, competent instructors to train the Owner's representatives who will be in charge of the apparatus and equipment, in the care, adjustment, and operation of all parts on the heating, air conditioning, ventilating, plumbing, fire protection, and automatic temperature control equipment. Instruction dates shall be scheduled at time of final inspection. A written report specifying times, dates, and name of personnel instructed shall be forwarded to the Architect. A minimum of four 8-hour instruction periods shall be provided. The instruction periods will be broken down to shorter periods when requested by the Owner. The total instruction hours shall not reduced. The ATC Contractor shall provide 4 hours of instructions. The remaining hours shall be divided between the mechanical and sheet metal Contractor.

- D. Guarantee: (1) year from the date of substantial completion as set by the architect and owner.
- E. By the acceptance of any contract award for the work herein described or shown on the drawings, the Contractor assumes the full responsibility imposed by the guarantee as set forth herein and in the General Conditions, and should protect himself through proper guarantees from equipment and special equipment Contractors and from subcontractors as their interests may appear.
- F. The guarantee so assumed by the Contractor and as work of this Section is as follows:
- G. That the entire mechanical system, including plumbing, heating, and air-conditioning system shall be quiet in operation.
- H. That the circulation of puron shall be complete and even.
- I. That all pipes, conduit, and connections shall be perfectly free from foreign matter and pockets and that all other obstructions to the free passage of air, water, liquid, sewage, and vent shall be removed.
- J. That he shall make promptly and free of charge, upon notice from the Owner, any necessary repairs due to defective workmanship or materials that may occur during a period of one year from date of Substantial Completion.
- K. That all specialties, mechanical, and patent devices incorporated in these systems shall be adjusted in a manner that each shall develop its maximum efficiency in the operation of the system; i.e., diffusers shall deliver the designed amount of air shown on drawings, thermostats shall operate to the specified limits, etc.
- L. All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect's Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any equipment supplier not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100-percent guarantee for the system and all items of equipment for this period. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly and or to meet the project schedule the guaranteed of all systems and equipment shall be as indicated above, on year from the date of the Architect's Certificate of Substantial Completion.
- M. All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be replaced.
- N. If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct-taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean.

1.29 CURBS

- A. Unless otherwise noted in these specifications or on the documents all roof curbs for all equipment are to be provided by Division 22 and 23. Curbs shall be adjustable for roof pitch.

1.30 TEST RUN

- A. The Mechanical Contractor shall operate the mechanical system for a minimum of 30 days to prove the operation of the system.

1.31 EQUIPMENT STARTUP AND CHECKOUT:

- A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.
- B. This contractor shall coordinate commissioning procedures and activities with the commissioning agent.

1.32 DEMOLITION

- 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:
- B. Proceed with 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.
- C. 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.
- D. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
- E. 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.

- F. Maintain adequate ventilation when using cutting torches.
- G. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
- H. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
- I. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- J. Dispose of demolished items and materials promptly.
- K. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- L. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- M. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- N. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- O. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- P. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

### 1.33 MOCK UP CLASSROOM

- A. A typical classroom, determined by the architect and owner, shall have its HVAC system installed early in the project for review and inspection by the owner, architect and engineer prior to the installation of HVAC in any other classroom. The system shall include; the heat pump, supply air duct, return air duct, outside air duct, and return piping with flexible hose kits and accessories, seismic restraints, piping restraints, fire protection sprinklers, thermostat, wiring and controls.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 23 0100

## **SECTION 230500 - COMMON WORK RESULTS FOR HVAC**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Mechanical sleeve seals.
  - 5. Sleeves.
  - 6. Escutcheons.
  - 7. Grout.
  - 8. Equipment installation requirements common to equipment sections.
  - 9. Painting and finishing.
  - 10. Concrete bases.
  - 11. Supports and anchorages.
  - 12. Link-Seal

#### **1.3 DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### 1.7 COORDINATION



- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Eslon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Thompson Plastics, Inc.

## 2.5 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Watts Industries, Inc.; Water Products Div

## 2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Stainless steel. Include two for each sealing element.
  4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.

## 2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  1. Finish: Polished chrome-plated and rough brass.
- D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- E. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

## 2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000-psi, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## 2.10 LINK-SEAL MODULAR SEAL PRESSURE PLATES

- A. Link-Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:
  1. Izod Impact - Notched = 2.05ft-lb/in. per ASTM D-256
  2. Flexural Strength @ Yield = 30,750 psi per ASTM D-790
  3. Flexural Modulus = 1,124,000 psi per ASTM D-790
  4. Elongation Break = 11.07% per ASTM D-638
  5. Specific Gravity = 1.38 per ASTM D-792
- B. Models LS200-275-300-315 shall incorporate the most current Link-Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top

(bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315-325-340-360-400-410-425-475-500-525-575-600 shall incorporate an integral recess known as a "Hex Nut Interlock" designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer's name molded into it.

- C. For fire service, pressure plates shall be steel with 2-part Zinc Dichromate Coating.
- D. Link-Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link-Seal® modular seal technical data. Bolts, flange hex nuts shall be:
  - 1. 316 Stainless Steel per ASTM F593-95, with a 85,000 psi average tensile strength.

### PART 3 - EXECUTION

#### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
  - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
  - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
  - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
  - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
  - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
  - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
  
- M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
  
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. PVC Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
  
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or

damaged. Do not use pipe sections that have cracked or open welds.

- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES



- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### 3.7 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

### 3.8 LINK SEAL

- A. Provide Link Seal at all piping penetrations from the outside.

END OF SECTION 230500

## **SECTION 230514 - VARIABLE FREQUENCY MOTOR DRIVES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Information contained on the drawings and/or schedules shall detail the additional specific requirements for the Variable Frequency Drive (VFD) system equipment.

#### **1.2 DESCRIPTION OF WORK:**

- A. Variable frequency drives (VFD) shall be provided by the automatic temperature controls contractor and installed by the electrician.
- B. Extent of variable frequency drive work as indicated by drawings and/or schedules and specified herein. Work includes complete installation, electrical connections, testing, and commissioning.
- C. Verify compatibility of VFD with motors supplied under Division 23. Review Division 23 specifications, plans, schedules, etc., to issue compatibility.
- D. The VFD installation, harmonic mitigation, and associated equipment coordination and interface shall be provided by Division 23. Mounting VFD and connecting 4-20mA control signal shall be by Division 23. Power wiring to and from the VFD to the motor shall be by Division 16.

#### **1.3 QUALITY ASSURANCE:**

- A. Comply with NEC, NEMA and IEEE (including Harmonic Standard IEEE-519) Standards as applicable to wiring methods, construction and installation of variable frequency drives. Comply with applicable requirements of UL 508, "Power Conversion Equipment". Provide complete packaged units which have been UL-listed and labeled by Underwriters Laboratory or ETL Testing Laboratories, Inc. Note: The entire unit shall carry the label, not just components.

#### **1.4 SUBMITTALS:**

- A. **PRODUCT DATA:** Submit manufacturer's data on variable frequency drives.
- B. **SHOP DRAWINGS:** Submit dimensioned drawings of variable frequency drives including, but not necessarily limited to, the following:
  - 1. Complete data sheet.
  - 2. Set of outline drawings giving complete mounting information, conduit entry and

3. exit dimensions, over all unit dimensions, weights, physical characteristics, etc.
  3. Set of complete electrical drawings for power and control wiring.
  4. Manufacture's literature giving detailed information of equipment being supplied including parts numbers, model numbers and ratings.
  5. Harmonic Distortion Limits: The VFD systems shall produce no more than 12% current THD and no more than 3% voltage THD throughout the normal operating range as measured at the input terminals of each VFD system on motors 10 H.P. and larger. For motors less than 10 H.P., provide AC line reactors with a minimum of 3% impedance. VFD supplier shall submit with the approval shop drawings their harmonic control scheme and actual test results for the proposed scheme on at least three of their existing installations. Data shall clearly identify what equipment is proposed and demonstrate that it routinely meets harmonic limits above for the applications similar to this project. Prior approvals also require this data.
- C. HARMONIC DISTORTION REPORT: After installation is complete, submit harmonic voltage and current distortion report as specified herein.

## PART 2 PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS:

- A. GENERAL: Subject to compliance with requirements, provide products manufactured by and supplied by one of the following vendors:

#### VFD MANUFACTURER

1. Mitsubishi
- B. VENDOR REQUIREMENTS: Vendors requesting approval by addendum must meet the following minimum requirements.
1. Must be actively engaged in manufacturing and supplying pulse width modulated variable frequency drives and built up systems, and must have a minimum of five years of experience in each supply or manufacture, as applicable.
  2. Must maintain full time service personal on call 24 hours/day as well as authorized parts and service facilities within 250 miles of the project with demonstrated record of service for at least the last three years.
  3. Must have UL 508C or ETL certification if project requires "built-up" assemblies which are not "factory-standard" products.
  4. Must be an ISO-9001 certified facility; manufacturing all products to ISO-9001 quality standards.

- C. The following manufacturers have been pre-approved to meet the harmonic testing and documentation section of this specification:
  - 1. Energy Management Corporation.
  - 2. Power Quality Consultants.
  
- D. HARMONIC TESTING: Harmonic testing must be performed by a manufacturer that is independent of the supplier.

Payment for the VFD materials and labor shall not be made until the harmonic testing has been completed and accepted.

## 2.2 GENERAL:

- A. Except as otherwise indicated, provide pulse width modulated variable frequency A.C. drives and ancillary components; of types, sizes, ratings and electrical characteristics indicated which comply with manufacturer's standard materials, design and construction in accordance with published information and as required for a complete installation.
  
- B. RS232 Computer Interface - Allows inverter to be controlled by a local computer terminal. Only one inverter may be controlled by each computer. All programming, monitoring, and control functions which are possible at the inverter may be performed through the computer terminal.

## 2.3 APPLICATION:

- A. Provide drive units which are applicable to the driven load characteristics. For centrifugal fan and pump applications, provide variable torque rated VFD's capable of providing 115% rated current for one minute. For conveyor, positive displacement pump, and compressor applications, provide constant torque rated VFD's capable of providing 150% of rated current for one minute. In addition, provide drives which meet the following operating conditions:
  - 1. Operable on facility power, with voltage and phase provided at building site, and without the need for isolation or step up/down transformers unless indicated.
  - 2. Capable of performing at an altitude of 4500 feet above sea level and have an operating temperature range 0° to 40°C (32° to 104°F) with a relative humidity of 0 to 90% (non-condensing). If mounted outdoors or in unconditioned spaces, provide environmental control necessary to operate in climate of -20°C to 50°C (-4° to 122°F), 0 to 100% R.H.

## 2.4 VARIABLE FREQUENCY DRIVE SYSTEM:

- A. The variable frequency AC drive shall convert 3 phase, 60 Hertz input power to an adjustable AC frequency and voltage for controlling the speed of AC squirrel cage motors. The rectifier section (converter) shall employ a diode or fully gated bridge to develop a constant DC bus voltage. Variable voltage rectifiers utilizing partially

gated SCR's are unacceptable. The DC bus shall utilize filter capacitors and DC link inductors to minimize generated harmonics. The PWM inverter control scheme shall produce an output wave form which closely approximates actual sine wave current. The output voltage shall vary proportionally with the output frequency to maintain a constant volts/hertz value up to 60 Hz. The output voltage will remain constant above 60 Hz. The continuous current rating shall be equal to or greater than the full load amperes required by the application. Provide units capable of starting and continuously driving the specified maximum motor load as identified on drawings and schedules. Provide units with input filters and line reactors.

- B. Provide system capable of operating without any system trip or damage based on the nominal power specifications and requirements indicated and subject to the following fluctuation:
  - 1. Plus or minus 10% voltage fluctuation.
  - 2. Plus or minus 3% frequency variation (5% if served by back-up generator)
  - 3. Distorted voltage waveform with up to 10% total voltage harmonic distortion.
  - 4. Provide system with voltage sag ride-through coordination under normal operating (average load) conditions to prevent nuisance trips with the following utility interruptions (based on preliminary IEEE working group P1346 data):
    - a. 0% voltage for 1 cycle.
    - b. 60% voltage for 10 cycles.
    - c. 87% voltage continuous.
- C. The drive shall have sufficient capacity to provide speed control of the motor throughout the operating range as specified herein.

## 2.5 EFFICIENCY AND POWER FACTOR:

- A. Provide solid state converter and inverter power switching components and controls to achieve a minimum 95% efficiency at full load and speed.
- B. The displacement power factor (as measured at the input to the VFD system) shall be 95% or better across the operational speed range.

## 2.6 PROTECTION:

- A. Provide short circuit protection by means of an externally operated, door interlocked circuit breaker or motor circuit protector (MCP) rated at 65,000 AIC minimum. Provide VFD's with fast acting semi-conductor fuses to protect against input short circuits. The door interlocked handle must be capable of being locked off to meet NEC requirements.
- B. Provide VFD operated motor overload protection by means of programmable, speed sensitive, electronic overload circuits with instantaneous trip, inverse time trip and current limit functions. These shall be adjustable and optimized for the application. Comply with NEC requirements and UL 991. In the by-pass mode provide motor overload relay set to protect the motor and capable of starting across the line.
- C. In addition to the protection above, provide over- and under-voltage protection, over-

temperature protection, ground fault protection, and control or microprocessor fault protection. These protective circuits shall cause an orderly shutdown of the VFD, provide indication of the fault condition, and require a manual reset (except undervoltage) before restart. Undervoltage from a power loss shall be set to automatically restart after return to normal. The history of the previous three faults shall be retained in a fault buffer for later review.

## 2.7 CONSTRUCTION:

- A. Provide NEMA configuration enclosure for each variable frequency drive system. The enclosure shall be either wall mounted or free standing, as required, with forced ventilation. Mount all components in a single enclosure including, but not limited to, the VFD unit, contactors, door interlocked circuit breaker and/or other items listed in the specification or shown on the drawings. All components shall be completely wired within the enclosure. Limit overall size of unit to space allocated on the drawings. Verify code required clearance requirements before manufacture and installation of unit.
- B. Indoor location: Provide NEMA 12 dust tight, non-ventilated enclosure, or NEMA 1 ventilated enclosure, ventilated by means of filtered air forced through the enclosure to create a positive internal pressure.
- C. Outdoor location or location exposed to weather: Provide NEMA 4 (wash down type), non-ventilated, enclosure. Locate all external heat sinks, fans, etc. associated with heat transfer in the rear of the enclosure with adequate stand offs for proper convection.
- D. Mount the variable frequency drive ancillary components on a removable panel within the enclosure such that panel is removable from enclosure for maintenance and part replacement.
- E. Provide "Machine Tool" type control transformer with primary and secondary fusing. All control power for operator devices and customer connections shall be 120 volts.
- F. Mount door with a minimum of two hinges with removable pins. Door shall be rigid and large doors shall have additional hinges and stiffening steel.
- G. Provide door mounted, industrial type, oil tight operator devices similar to those found on motor control centers.
- H. Paint enclosure with high grade epoxy (ANSI 61 Grey), a minimum of 50-70 microns thick.
- I. Provide an electrical shock warning label to warn personnel that a potential of electric shock exists.
- J. Provide screened or engraved labels on all door operator and pilot devices.

## 2.8 STANDARD FEATURES:

- A. Provide the following standard features on all VFD units:

Window Rock Office Building and Site  
Construction Documents

1. Motor Braking Torque shall be accomplished by means of DC injection into the motor or by regenerative braking.
  2. The drive shall contain an output frequency clamp such that minimum or maximum output frequency can be set at desired limits.
  3. Frequency Jump: The drive shall be supplied with frequency jump control to avoid operating at a point of resonance with the natural frequency of the machine.
  4. Synchronous Transfer: Provide synchronous transfer feature to allow transfer of motor from VFD to the utility line and back to VFD operation while the motor is running.
- B. Provide the following door mounted operator controls as a minimum:
1. Hand/Off/Auto switch
  2. Local/Remote speed control
  3. Frequency setting speed pot
  4. Frequency indication meter calibrated in % speed.
  5. Motor voltage indication
  6. Motor current indication
  7. VFD enable light
  8. VFD fault light
  9. External fault light (safeties interlock). If drive has an english character based display, this indication can be shown on that display in lieu of a pilot light.
- C. Provide a minimum of the following protective features with an alarm display indication:
1. Instantaneous overcurrent
  2. Motor stalled
  3. Motor overload
  4. Heatsink over temperature
  5. Power loss
  6. Output ground fault
  7. Output short circuit
  8. Loss of process speed signal (i.e. 4-20 ma.)
  9. Microprocessor malfunction
- D. Provide the following termination points on a terminal strip for field connection:
1. Safeties interlock connection
  2. Remote Start/Stop connection
  3. Remote VFD fault connection
  4. Remote VFD enable connection
  5. Remote speed reference signal input (See item G below)
- E. Provide the following parameter adjustments to tune the VFD system:
1. Minimum and maximum speeds; maximum output voltage at output frequency
  2. Acceleration and deceleration times (adjustable from 1 to 120 seconds, minimum)
  3. Overcurrent trip point

4. Current limit response to overload
  5. Adjustable carrier frequency to minimize audible motor noise.
  6. DC boost to automatically (or manually, 3%) adjust boost voltage on each start to compensate for load changes.
- F. The VFD shall be capable of starting into a rotating motor at any speed.
- G. Remote signal connection terminals (0-5 VDC or 0-10 VDC = 0-100% speed or 4-20 ma = 20-100% Speed). Analog signals shall be programmable as normal or inverted.
- H. The VFD shall have a programmable response to loss of a 4-20 ma signal. The following responses are acceptable.
1. Fault and stop the drive.
  2. Alarm and maintain last reference (within 10%)
  3. Alarm and go to preset speed
  4. Alarm and go to minimum speed
  5. Alarm and go to maximum speed
- I. The VFD shall have a programmable analog output rated either 0-20 ma or 0-5 volts to represent one of the following:
1. Proportional to output frequency
  2. Proportional to output current
  3. Proportional to DC bus voltage
  4. Proportional to output power
  5. A programmable output offset shall be provided to allow modification of the analog output to obtain 2-10 volt DC or 4-20 ma.
- J. The VFD shall have output relay contacts rated 115 volt AC/30 volt DC 5 amp resistive, 2 amp inductive. The contacts shall be:
1. Form A run contact
  2. Form C fault contact
  3. Form C alarm contact
  4. Form A programmable contact to change state upon the following conditions: at speed, at frequency, at current, or at torque
- K. Provide VFD with transient voltage surge suppression with maximum UL 1449 suppression rating of 1000 volts, line to ground on 480 volt systems, and 500 volts, line to ground on 208 volt systems.

## 2.9 TESTING:

- A. Prior to shipping, test each unit and provide a certified test report with each unit. Standard tests shall include:
1. Visual inspection: Consisting of checking unit enclosure, wiring, connections, fasteners, covers and locking mechanism.
  2. High pot test: Two (2)X rated voltage plus 1000 volts AC for 60 seconds shall



be applied per UL 508 on all peripheral drive system power components (circuit breakers, contactors, motor overloads, line reactor, disconnect switches etc.) as a complete package. A copy of test results shall be included in operation manuals.

3. System run test under actual motor load.
4. Control panel devices: test all devices, lights, switches, etc.
5. Additional Equipment: test additional equipment specified with VFD system.
6. Special tests: as required and specified.

### PART 3 EXECUTION

#### 3.1 MECHANICAL COORDINATION:

- A. Meet with the supplier of the mechanical equipment and determine the exact characteristics of the motors for which VFD's are to be provided. Verify the exact control requirements, including interface signal type, reversing/non-reversing drives, interlocks, etc.

#### 3.2 INSTALLATION OF VARIABLE FREQUENCY DRIVES:

- A. Install variable frequency drives as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

#### 3.3 MOTOR DISCONNECT INTERLOCK:

- A. Where motor disconnect switches are installed on the load side of VFD's, provide late-make, early-break auxiliary contacts on each disconnect switch. Wire auxiliary contact to VFD safety contact, such that disconnecting the motor will shut down the drive first, and closing the switch will start the drive only after power is applied to the motor.

#### 3.4 ADJUST AND CLEAN:

- A. Inspect operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finish.

#### 3.5 START-UP SERVICES:

- A. The supplier of the AC drive described herein, shall provide field start-up service by an authorized factory trained service representative. The factory representative shall be trained in the maintenance and troubleshooting of the equipment as specified herein. Start-up service shall include system check-out, start-up and system run, and harmonic testing.

1. Verify that the input voltage is within the manufacturer's specification tolerances.
2. Verify that the motor rotation is correct in all modes of operation.
3. Verify all operator devices, programming and monitoring functions to be fully operational.
4. Verify operation of all field signal control connections.
5. Measure and record system output voltage and current at 50% and 100% speed. Tune the output voltage to correspond to motor nameplate data.
6. Make all parameter adjustments to tune and optimize the VFD system to the application. Record all configuration values as part of this report.
7. Conduct harmonic tests as identified below.

B. Provide owner training for each model and type of VFD system provided.

### 3.6 HARMONIC DISTORTION REPORT:

A. After installation is complete, measure the harmonic voltage and current distortion of each Variable Frequency Drive, with the VFD unit running at 50% operating speed and at highest operating speed. Take measurements on each phase (L-L and L-N) on the line side (input terminals) of the VFD.

B. Submit report which includes the following:

1. Data (text and graphical) showing voltage and current waveforms, voltage and current THD and individual harmonic spectrum analysis.
2. Power quality reports including telephone influence factor, true and displacement power factor, and voltage and current imbalance.

C. Provide the Engineer with two copies of the harmonic distortion report.

### 3.7 OPERATION AND MAINTENANCE MANUALS:

A. The vendor shall supply two complete manuals consisting of, as a minimum, general system arrangement, power wiring diagram, control wiring diagram, schematic of VFD System components and options, factory test reports, trouble shooting data, parts lists, and preventative maintenance information.

B. Prior to final acceptance, provide the engineer with two (2) copies of the harmonic distortion report. If the harmonics exceed the specified limits, VFD system will be rejected. The VFD vendor shall then have thirty (30) days to revise the harmonic control scheme and resubmit new shop drawings and new harmonic verification test reports for final acceptance. All costs resulting from non-compliance rejection, including additional engineer and contractor review time, will be paid by the VFD supplier.

END OF SECTION 230514

## **SECTION 230523 – GENERAL PIPING VALVES FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes general duty valves common to several mechanical piping systems.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Special purpose valves are specified in Division 23 Sections.
  - 2. Valve tags and charts are specified in Division 23 Section "Identification for HVAC piping and equipment."

#### **1.3 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

#### **1.4 QUALITY ASSURANCE**

- A. Single-Source Responsibility: Comply with the requirements specified in Division 1 Section "Materials and Equipment," under "Source Limitations" Paragraph.
- B. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

## 1.5 DELIVERY, STORAGE, AND HANDLING

### A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set globe and gate valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

### B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store indoors and maintain valve temperature higher than ambient dew-point temperature.  
If outdoor storage is necessary, store valves off the ground in watertight enclosures.

### C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

#### A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bray
2. Center Line
3. Conbraco Industries, Inc., Apollo Division
4. Cla-Val Company
5. Grinnell Corporation
6. Hammond Valve Corporation
7. Keystone Valve USA, Inc.
8. Metraflex Company
9. Milwaukee Valve Company, Inc.
10. NIBCO, Inc.
11. Stockham Valves & Fittings, Inc.
12. Titan
13. Val-Matic Valve & Mfg. Corporation
14. Victaulic Company of America

### 2.2 BASIC, COMMON FEATURES

#### A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.

1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.
- B. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
- C. Sizes: Same size as upstream pipe, unless otherwise indicated.
- D. Operators: Use specified operators and handwheels, except provide the following special operator features:
  1. Handwheels: For valves other than quarter turn.
  2. Lever Handles: For quarter-turn valves 6 inches and smaller, except for plug valves, which shall have square heads. Furnish Owner with 1 wrench for every 10 plug valves.
  3. Chain-Wheel Operators: For valves 4 inches and larger, installed 120 inches or higher above finished floor elevation.
  4. Gear-Drive Operators: For quarter-turn valves 8 inches and larger.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
- G. Threads: ASME B1.20.1.
- H. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
- I. Solder Joint: ASME B16.18.
  1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

### 2.3 GATE VALVES

- A. No gate valves will be used on this project.

### 2.4 BALL VALVES, HOT & CHILLED WATER

- A. Ball Valves, 4 Inches and Smaller: MSS SP-110, 600-psi CWP, ASTM B 584 ,B 61 or B 62 bronze body (containing no more than 15% zinc), 2-piece construction; chrome-plated, full port, brass ball; blowout proof; silicon- bronze or silicon-brass stem; teflon seats and seals; threaded or soldered end connections, valves for HVAC, steam and condensate service must have threaded end connections:

1. Operator: Vinyl-covered steel lever handle for sizes 2-1/2" and smaller.
2. Operator: Lever operators with lock for sizes 3" and larger.
3. Valves shall be equipped with 2" extended handles of non-thermal conductive material.
4. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Supply with memory stops, which are fully adjustable after insulation is applied.
5. Memory Stop: For operator handles.

## 2.5 PLUG VALVES

- A. Plug Valves: MSS SP-78, 175-psi CWP, ASTM A 126 cast-iron body and bonnet, cast-iron plug, Viton, or teflon packing, flanged or grooved end connections:
1. Operator: Square head with 1 wrench for every 10 valves.
  2. Operator: Worm and gear with handwheel, sizes 6 inches and larger.
  3. Operator: Worm and gear with chain wheel, sizes 6 inches and larger, 120 inches or higher above floor.

## 2.6 GLOBE VALVES

- A. Globe Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 150, 300-psi CWP; ASTM B 62 cast-bronze body and screwed bonnet, rubber, bronze, or teflon disc, silicon bronze-alloy stem, teflon-impregnated packing with bronze packing nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.
- B. Globe Valves, 3 Inches and Larger: MSS SP-85, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted bonnet with bronze fittings, renewable bronze seat and disc, brass-alloy stem, outside screw and yoke, teflon-impregnated packing with cast-iron follower, flanged end connections; and with cast-iron handwheel.

## 2.7 BUTTERFLY VALVES

- A. Butterfly Valves: MSS SP-67 200/250 CWP, ASTM A536 Ductile Iron, full lug body, 2 inch extended neck, 316 stainless steel or aluminum-bronze disc, slide through one piece 400 series stainless steel stem design with geometric connection to disc no taper pins, molded-in EPDM seat liner. Valves must be suitable for bi-directional dead end service at valves dead and rated pressure service with out the need for downstream flanges. The disk can be made of stainless steel for chilled water valves.

Operator for sizes 2-1/2" to 6": Lever handle with latch lock.

Operator for sizes 8" to 24": Weather-proof Handwheel gear operator.

Operator for 8" and larger, 120 " or higher above floor: Cain-wheel operator assembly.

- B. Butterfly Valves for high pressure applications:

Valves shall meet the requirements of MSS SP-68, High Pressure Butterfly Valves with Offset Design. Unless otherwise indicated, full lug type valves suitable for bi-directional end of line service at full rated pressure, without the need of a downstream flange. ANSI Class 150 or 300, Carbon Steel Body, Stainless Steel Disc, Stainless Steel or Duplex Steel Stem, PTFE Seats, PTFE or Graphite Seals. Permanently lubricated bearings of 316 Stainless Steel with Graphite. 2 1/2" to 6" shall have lever lock operator, 8" and larger shall have gear operators or Pneumatic/Electric Actuators.

NIBCO Figure Number LCS6822 (Class 150)

NIBCO Figure Number LCS7822 (Class 300)

## 2.8 CHECK VALVES

- A. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and bonnet cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:
- B. Swing Check Valves, 3 Inches and Larger: MSS SP-71 Type 1, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted bonnet cap, horizontal-swing bronze disc, flanged or grooved end connections.
  - 1. On sumpump discharge use swing check valve with external spring or lever and weight.
- C. Wafer Check Valves: Class 125, 200-psi CWP, ASTM A 126 cast-iron body, bronze disc/plates, stainless-steel pins and springs, Buna N seals, installed between flanges.
  - 1. On grooved piping systems use grooved by grooved check valve in lieu of flanged or wafer with grooved flange adapters.
- D. Lift Check Valves: Class 125, ASTM B 62 bronze body and cap (main components), horizontal or vertical pattern, lift-type, bronze disc or Buna N rubber disc with stainless-steel holder threaded or soldered end connections.

## 2.9 DRAIN VALVES

- A. Full port bronze ball valves with 3/4" hose thread outlet and hose cap and chain.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

### 3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. For chain-wheel operators, extend chains to 78 inches above finished floor elevation.
- H. Installation of Check Valves: Install for proper direction of flow as follows:
  - 1. Swing Check Valves: Horizontal position with hinge pin level.
  - 2. Wafer Check Valves: Horizontal or vertical position, between flanges.
  - 3. Lift Check Valve: With stem upright and plumb.

Note – Install all checks a minimum of 5 pipe diameters downstream of pump discharge or elbow to avoid flow turbulence. Flow straighteners may be needed in extreme cases.

### 3.3 SOLDERED CONNECTIONS

- A. Cut tube square and to exact lengths.



- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Open gate and globe valves to fully open position.
- E. Remove the cap and disc holder of swing check valves having composition discs.
- F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.
- G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

#### 3.4 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

#### 3.5 FLANGED CONNECTIONS

- A. Align flange surfaces parallel.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- C. For dead-end service, all butterfly valves, except for the NIBCO LD2000 / 3000, require flanges both upstream and downstream for proper shutoff and retention. NIBCO LD2000 / 3000 series butterfly valves are suitable for bubbletight dead-end service with out the need for a downstream flange.

#### 3.6 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
  - 1. Copper Tube Size, 2-1/2 Inches and Smaller: Solder ends, except provide threaded ends for HVAC and low-pressure steam service.
  - 2. Steel Pipe Sizes, 2-1/2 Inches and Smaller: Threaded or grooved end.
  - 3. Steel Pipe Sizes, 3 Inches and Larger: Grooved end or flanged.

### 3.7 APPLICATION

- A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.

### 3.8 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 230523

## **SECTION 230529 - HANGERS AND SUPPORTS**

### **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 the following hangers and supports for HVAC system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
- B. Related Sections include the following:
  - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
  - 3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

#### **1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

Window Rock Office Building and Site  
Construction Documents

- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Mechanical Anchors: ICC-ES Evaluation Reports validating 'Cracked Concrete' testing per A.C. 193 must be provided for anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers. Include Product Data for components.
  - 2. Metal framing systems. Include Product Data for components.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel." ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. AWS D1.2, "Structural Welding Code--Aluminum."
  - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
  - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
  - 5. ASME Boiler and Pressure Vessel Code: Section IX.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

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B. Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.
15. Simpson Strong-Tie Co.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. Hilti, Inc.
4. GS Metals Corp.
5. Power-Strut Div.; Tyco International, Ltd.
6. Thomas & Betts Corporation.
7. Tolco Inc.
8. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

## 2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
  - 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
  - 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.

12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
  16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18 or Simpson Blue Banger Concrete insert with UL & FM approvals): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint

- construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:



- a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): Mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use mechanical-expansion anchors or screw instead of building attachments where required in concrete construction. For anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems, anchors shall have been tested for 'Cracked Concrete' per A.C. 193 and shall have a valid ICC-ES Evaluation Report

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
- 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- F. Install lateral bracing with pipe hangers and supports to prevent swaying. For applications where seismic bracing is required, 'Cracked Concrete' expansion anchors or concrete screws tested per A.C. 193 must be provided for seismic bracing anchorage where post-installed anchors are required.
- G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- H. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- J. Insulated Piping: Comply with the following:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  - 5. Pipes NPS 8 and Larger: Include wood inserts.
  - 6. Insert Material: Length at least as long as protective shield.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

Window Rock Office Building and Site  
Construction Documents

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

## **SECTION 230550 - OPERATIONS & MAINTENANCE MANUALS**

### **PART 1- GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. All pertinent sections of Division 21, 22, & 23 Mechanical General Requirements, are part of the work of this Section. Division 1 is part of this and all other sections of these specifications.
  - 1. Testing and Balancing is specified in section 230594.
  - 2. Training and Instructions to Owner's Representative is specified in section 230100.

#### **1.2 SCOPE OF WORK**

- A. Submission of Operating and Maintenance Manuals complete with Balancing reports. (Coordinate with Division 1).
- B. Coordination of work required for system commissioning.

#### **1.3 SUBMITTALS**

- A. Submit product data in accordance with Division 1 and Section 230100. Submit the following:
- B. Sample of O and M manual outline.

### **PART 2 - PRODUCTS**

#### **2.1 O & M MANUALS**

- A. The operating and maintenance manuals shall be as follows:
  - 1. Binders shall be red buckram with easy-view metal for size 8-1/2 x 11-inch sheets, with capacity expandable from 2 inches to 3-1/2 inches as required for the project. Construction shall be rivet-through with library corners. No. 12 backbone and lining shall be the same material as the cover. The front cover and backbone shall be foil-stamped in white as follows: (coordinate with Section 1730)

OPERATING AND MAINTENANCE  
MANUAL  
FOR THE

(INSERT PROJECT NAME)

(INSERT PROJECT COMPLETION YEAR)

VOLUME No. ( )

(INSERT ARCHITECT)

### PART 3- EXECUTION

#### 3.1 OPERATING AND MAINTENANCE MANUALS:

- A. Work under this section shall be performed in concert with the contractor performing the system testing and balancing. Six (6) copies of the manuals shall be furnished to the Architect for distribution to the owner.
- B. The "Start-Up and Operation" section is one of the most important in the manual. Information in this section shall be complete and accurately written and shall be verified with the actual equipment on the job, such as switches, starters, relays, automatic controls, etc. A step-by-step start-up procedure shall be described.
- C. The manuals shall include balancing reports, system commissioning procedures, start-up tests and reports, equipment and system performance test reports, warranties, and certificates of training given to the owner's representatives.
- D. An index sheet typed on AICO Gold-Line indexes shall be provided in the front of the binder. The manual shall include the following:

SYSTEM DESCRIPTIONS

START-UP PROCEDURE AND OPERATION OF SYSTEM

MAINTENANCE AND LUBRICATION TABLE

OPERATION AND MAINTENANCE BULLETINS

AUTOMATIC TEMPERATURE CONTROL DESCRIPTION OF OPERATION,  
INTERLOCK AND CONTROL DIAGRAMS, AND CONTROL PANELS.

AIR BALANCING REPORTS EQUIPMENT WARRANTIES AND

TRAINING CERTIFICATES SYSTEM COMMISSIONING

REPORTS

EQUIPMENT START-UP CERTIFICATES

END OF SECTION 230550

## **SECTION 230713 - DUCT INSULATION**

### **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 insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, concealed return located in unconditioned space.
- B. Related Sections:
  - 1. Division 23 Section "HVAC Equipment Insulation."
  - 2. Division 23 Section "HVAC Piping Insulation."
  - 3. Division 23 Section "Metal Ducts" for duct liners.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.
- C. Qualification Data: For qualified Installer.
- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- E. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

#### 1.7 SCHEDULING

- A. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

### PART 2 - PRODUCTS

#### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.



- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.

## 2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Johns Manville; Super Firetemp M.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; FlameChek.
    - b. Johns Manville; Firetemp Wrap.
    - c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
    - d. Thermal Ceramics; FireMaster Duct Wrap.
    - e. 3M; Fire Barrier Wrap Products.
    - f. Unifrax Corporation; FyreWrap.

### 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; AeroSeal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.
  2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2007 Addenda.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2007 Addenda.
- D. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Use adhesive that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2007 Addenda.

#### 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.

- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    - b. Eagle Bridges - Marathon Industries; 550.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
    - d. Mon-Eco Industries, Inc.; 55-50.
    - e. Vimasco Corporation; WC-1/WC-5.
  - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 4. Solids Content: 60 percent by volume and 66 percent by weight.
  - 5. Color: White.

## 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
  - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    - c. Vimasco Corporation; 713 and 714.
  - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  - 4. Service Temperature Range: 0 to plus 180 deg F.
  - 5. Color: White.

## 2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    - b. Eagle Bridges - Marathon Industries; 405.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    - d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2007 Addenda.

## 2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
  1. Color: Color as selected by Architect.
- C. Metal Jacket:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
    - c. RPR Products, Inc.; Insul-Mate.
  2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.

## 2.9 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive;

complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ABI, Ideal Tape Division; 491 AWF FSK.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
  - c. Compac Corporation; 110 and 111.
  - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ABI, Ideal Tape Division; 488 AWF.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
  - c. Compac Corporation; 120.
  - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

## 2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements provide one of the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Aluminum: ASTM B 209 Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.

Window Rock Office Building and Site  
Construction Documents

- a. Products: Subject to compliance with requirements, provide one of the following:
  - 1) AGM Industries, Inc.; CWP-1.
  - 2) GEMCO; CD.
  - 3) Midwest Fasteners, Inc.; CD.
  - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CHP-1.
    - 2) GEMCO; Cupped Head Weld Pin.
    - 3) Midwest Fasteners, Inc.; Cupped Head.
    - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) GEMCO; Nylon Hangers.
    - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
  - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
  - c. Spindle: Nylon, 0.106-inch diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.

- d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
    - 2) GEMCO; Peel & Press.
    - 3) Midwest Fasteners, Inc.; Self Stick.
  - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

#### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.



- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking

due to thermal movement.

- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
  - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
  - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  - 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  - 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of

stiffener, hanger, and flange with pins spaced 6 inches o.c.

- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with

factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

### 3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of

insulation manufacturer's recommended protective coating.

- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.11 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, concealed return located in unconditioned space.
  - 3. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
  - 4. Outdoor, concealed supply and return.
  - 5. Outdoor, exposed supply and return.
- B. Items Not Insulated:
  - 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 2. Factory-insulated flexible ducts.
  - 3. Factory-insulated plenums and casings.
  - 4. Flexible connectors.
  - 5. Vibration-control devices.
  - 6. Factory-insulated access panels and doors.

### 3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round, rectangular and flat-oval, supply, return and outdoor air duct insulation shall be one of the following:

Window Rock Office Building and Site  
Construction Documents

1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. Nominal density.
- B. Concealed, supply, return outdoor air plenum insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
- C. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket thickness as required to achieve 2-hour fire rating.
- a. Ductwork is to be wrapped with 2 layers of approved fire wrap that meets ASTM E-2336.

END OF SECTION 230713

## **SECTION 230720 - PIPE INSULATION**

### **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 preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
  - 1. Division 23 Section "Duct Insulation" for insulation for ducts and plenums.
  - 2. Division 23 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

#### **1.3 SUBMITTALS**

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
  - 2. Attachment and covering of heat trace inside insulation.
  - 3. Insulation application at pipe expansion joints for each type of insulation.
  - 4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Removable insulation at piping specialties and equipment connections.
  - 6. Application of field-applied jackets.
- C. 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.
- D. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

#### **1.4 QUALITY ASSURANCE**



Window Rock Office Building and Site  
Construction Documents

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for insulation application.

1.7 SCHEDULING

- A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Mineral-Fiber Insulation:

- a. CertainTeed Manson.
  - b. Knauf FiberGlass GmbH.
  - c. Owens-Corning Fiberglas Corp.
  - d. Schuller International, Inc.
  - e. John Manville.
2. Flexible Elastomeric Thermal Insulation:
- a. Armstrong World Industries, Inc.
  - b. Rubatex Corp.
3. Calcium Silicate Insulation:
- a. Owens-Corning Fiberglas Corp.
  - b. Pabco.
  - c. Schuller International, Inc.
  - d. John Manville.

## 2.2 INSULATION MATERIALS

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
  2. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
  3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
    - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
    - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
  4. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
  5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
  6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
  7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. Calcium Silicate Insulation: Preformed pipe sections of noncombustible, inorganic, hydrous calcium silicate with a nonasbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

### 2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
  - 1. Finish and Thickness: Smooth finish, 0.010 inch thick.
  - 2. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
  - 3. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
  - 4. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

### 2.4 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

### 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
  - 1. Apply insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
  - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

- a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
  4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
  5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
  2. Apply insulation for exterior applications tightly joined to interior insulation ends.
  3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- R. Interior Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Firestopping."
- S. Floor Penetrations: Apply insulation continuously through floor assembly.
1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

### 3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
  2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
  3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers.
4. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
6. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

### 3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus

twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:

1. Apply metered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

### 3.6 FIELD-APPLIED JACKET APPLICATION

- A. Apply PVC jacket where indicated, with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive. Color for each piping system shall be selected by the Architect.
- B. Apply metal jacket where indicated, with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.7 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

### 3.8 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
1. Flexible connectors.
  2. Vibration-control devices.
  3. Below-grade piping, unless otherwise indicated.
  4. Chrome-plated pipes and fittings, unless potential for personnel injury.
  5. Non-Chilled water air chambers, unions, strainers, check valves, plug valves, and flow regulators.

### 3.9 INSULATION APPLICATION SCHEDULE, GENERAL

- A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
- B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

### 3.10 INSULATION APPLICATION SCHEDULE

- A. Service: Condenser-water supply and return & exterior make-up water to cooling towers.
1. Operating Temperature: 35 to 90 deg F.
  2. Insulation Material: Flexible elastomeric.
  3. Insulation Thickness: 1 inch inside building and 1-1/2 inch outside building. (Exterior condenser water and makeup water piping to cooling tower is to be wrapped with electric heat trace.
  4. Field-Applied Jacket: Aluminum on exterior piping (PVC on interior fittings)
  5. Vapor Retarder Required: Yes.
  6. Finish: Painted.

END OF SECTION 230720



## SECTION 230993 – SEQUENCES OF OPERATION

### 1. POWER FAILURE

- a. All fan systems and exhaust fans shall be commanded off on detection of power failure. After power is restored, the fans shall be started sequentially. All supply, relief and interlocked exhaust fans shall stop on power failure. When power has been restored to normal for a minimum of two minutes, the fans shall restart at 30-second intervals (adjustable). This restart sequence shall be changeable by the operator.

### 2. SCHEDULE

- a. Although specific set points, time periods and reset values are listed in the sequence of operation, all values shall be changeable through the Facility Management System console or portable operators' terminal. The initial occupied/unoccupied schedules shall be as designated by the owner's representative. Schedules shall allow the owner the option to change the operation to occupied/unoccupied.

### 3. POINT DATABASE

- a. Inputs and outputs required to meet the sequence of operation shall be provided, whether or not they are listed in the Input/Output schedule. All points listed in the Input/Output schedule shall also be provided.

### 4. HEAT PUMPS

- a. During the occupied mode as determined by the programmable thermostat, the heat pump shall operate to satisfy the thermostat set point. The heat pump blower fan shall operate continuously during the occupied mode.
- b. If the outside air temperature is below 35 degrees, the 2-way ATC valves at each rooftop heat pump shall open and shall remain open until the outside air temperature rises above 38 degrees.
- c. A discharge air sensor shall be installed for every heat pump and value made available to the BAS for monitoring and display.
- d. In the unoccupied mode the heat pump shall be off unless the unoccupied set point is not satisfied. In that case the heat pump shall open the associated ATC valve, start the blower fan and cycle on long enough to satisfy the unoccupied set point. At the call for heating or cooling from any thermostat, the peer to peer communication between the thermostats shall alert ATC system to start loop pump(s). The loop pump(s) shall continue to operate for 15 minutes (adj.) after all calls for heating or cooling have been satisfied. An override button on the thermostat shall return the heat pump to the occupied mode for a certain period of time (adjustable).

**7. LEAK DETECTION**

- a. The ATC contractor shall provide sensors to monitor the pressure in air handling unit glycol system. When the sensor senses a leak as indicated by a drop in system pressure, the ATC controls shall send an alarm.

**8. EXHAUST FANS**

- a. See exhaust fan schedule to identify control sequence.
- b. The DDC System shall monitor the exhaust fan status using a current switch and generate an alarm if status deviates from required operation.

**9. DOMESTIC HOT WATER CONTROL**

- a. The domestic hot water heaters shall be furnished complete with controls.
- b. The domestic hot water recirculating pumps shall be enabled in the occupied mode. A return water aquastat will cycle the pumps as necessary to maintain setpoint when the pumps are enabled. The pumps shall be off in the unoccupied mode.
- c. Thermostatic mixing valves shall be furnished by the ATC Contractor and installed under the Plumbing Section of these specifications to provide domestic hot water. Each domestic hot water recirculating pump shall be cycled by a strap-on thermostat on the return water line to maintain a setpoint 5 degrees less than the supply water temperature setpoint. Each control valve shall be spring return type, piped to fail to the cold water position on loss of power. A manual reset remote bulb temperature sensor located in the discharge side of each control valve shall close the three way valve if the discharge temperature exceeds the control setpoint by 5 degrees. When activated, an alarm shall be generated at the operator's terminal.

**10. DIAL OUT**

- a. The Building Automation System shall be programmed to automatically dial up to four pager or telephone numbers or remote terminals for after-hours notification of an equipment failure, or operator selected alarm. A preprogrammed voice message shall be used for telephone dial-out, notifying the maintenance personnel of a system alarm, such as high freezer temperature.

System	Heat Pumps					
Point	D	M	A	L	S	GC
Do Heat Pump Enable						

Window Rock Office Building and Site  
Construction Documents

DI Heat Pump Status						
UI Discharge Air Temp						
UI Room Temp						

END OF SECTION 230993

## **SECTION 233001 - COMMON DUCT REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

**A. Includes But Not Limited To:**

1. General procedures and requirements for ductwork.
2. Repair leaks in ductwork, as identified by smoke test, at no additional cost to Owner.
3. Soundproofing procedures for duct penetrations of walls, ceilings, and floors in mechanical equipment rooms.

**B. Related Sections:**

1. Section 07 9219: Quality of acoustic sealant.
2. Section 23 0500: Common HVAC Requirements.
3. Section 23 0594: Air test and balance and smoke testing of ductwork.

#### **1.2 SUBMITTALS**

**A. Samples: Sealer and gauze proposed for sealing ductwork.**

**B. Quality Assurance / Control:**

1. Manufacturer's installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.
2. Specification data on sealer and gauze proposed for sealing ductwork.

#### **1.3 QUALITY ASSURANCE**

**A. Requirements: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA HVAC Duct Construction Standards.**

**B. Pre-Installation Conference: Schedule conference immediately before installation of ductwork.**

## PART 2 - PRODUCTS

- A. Finishes, Where Applicable: Colors as selected by Architect.
  
- B. Duct Hangers:
  - 1. One inch by 18 ga galvanized steel straps or steel rods as shown on Drawings and spaced not more than 96 inches apart.
  - 2. Attaching screws at trusses shall be 2 inch No. 10 round head wood screws. Nails not allowed.
  - 3. Attach threaded rod to steel joist with Grinnell Steel washer plate Fig. 60 - ph-1. Double nut connection.
  
- C. Penetration Soundproofing Materials:
  - 1. Insulation for Packing: Fiberglass.
  - 2. Calking: Polysulphide.
  - 3. Escutcheon Frame: 22 ga galvanized iron 2 inches wide.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.
  
- B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.
  
- C. Hangers And Supports:
  - 1. Install pair of hangers close to each transverse joint and elsewhere as required by spacing indicated in table on Drawings.
  - 2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
  - 3. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
  - 4. Where hangers are secured to forms before concrete slabs are poured, cut off flush

233001 - 2

all nails, strap ends, and other projections after forms are removed.

5. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.

D. Penetration Soundproofing

1. Pack space between ducts and structure full of fiberglass insulation of sufficient thickness to be wedged tight, allowing space for application of caulking.
2. Provide caulking at least 2 inches thick between duct and structure on both ends of opening through structure.
3. Provide metal escutcheon on Equipment Room side. Secure escutcheon to wall.

3.2 CLEANING

- A. Clean interior of duct systems before final completion.

END OF SECTION 23 30 01

## **SECTION 233113 - METAL DUCTS**

### **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. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Double-wall round and flat-oval ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.
8. Seismic-restraint devices.

- B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

#### 1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.
4. Round and flat oval duct.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
13. The shop drawings shall include the Rectangular and round ductwork construction and reinforcement methods which the contractor is proposing for this project. This shall be determined by the contractor by following the latest edition of SMACNA "HVAC duct construction Standards". Duct fabrication shall not begin until these shop drawings and be submitted and reviewed.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
  - a. Lighting fixtures.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Access panels.
  - f. Perimeter moldings.



- D. Field quality-control reports.

## 1.5 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6.4.4 - "HVAC System Construction and Insulation."

## PART 2 - PRODUCTS

### 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static- pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated. Longitudinal ductwork is not allowed. All round ductwork shall have the Spiral seam.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Sheet Metal Connectors, Inc.
    - e. Spiral Manufacturing Co., Inc.

- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Not Allowed.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.3 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Lindab Inc.
  - 2. McGill AirFlow LLC.
  - 3. SEMCO Incorporated.
  - 4. Sheet Metal Connectors, Inc.
  - 5. Spiral, Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
  - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
  - 2. Longitudinal Seams: Not Allowed.
  - 3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and

Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch diameter perforations, with overall open area of 23 percent.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  - 3. Coat insulation with antimicrobial coating.
  - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
  - 1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

#### 2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 and 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum

ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CertainTeed Corporation; Insulation Group.
  - b. Johns Manville.
  - c. Knauf Insulation.
  - d. Owens Corning.
2. Maximum Thermal Conductivity:
  - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F 75 deg F mean temperature.
3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
  - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Aeroflex USA Inc.
  - b. Armacell LLC.
  - c. Rubatex International, LLC
2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

- a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick aluminum or stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches diameter.
- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  3. Butt transverse joints without gaps, and coat joint with adhesive.
  4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted- edge overlapping.
  5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
  6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm .
  7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
  8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    - a. Fan discharges.
    - b. Intervals of lined duct preceding unlined duct.
    - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
  9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
    - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
  10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other

buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg , positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.

11. Service: Indoor or outdoor.
  12. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
  6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with

zinc chromate.

## 2.8 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
  2. Ductmate Industries, Inc.
  3. Hilti Corp.
  4. Kinetics Noise Control.
  5. Unistrut Corporation; Tyco International, Ltd.
  6. Vibro Acoustics.
- B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- C. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated after coordination with all other trades. Submit Shop Drawings and Coordination Drawings to insure ductwork system with fit. Make necessary's offsets and modifications to insure the ductwork system will fit in the allotted space.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.



- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

### 3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.
- F. Paint ductwork as directed by the architect.

### 3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Below are general seal Class. Refer to standards for exact Seal Class.
  - 2. Outdoor, Supply-Air Ducts: Seal Class A.
  - 3. Outdoor, Exhaust Ducts: Seal Class C.
  - 4. Outdoor, Return-Air Ducts: Seal Class C.
  - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
  - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
  - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
  - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
  - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
  - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
  - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
  - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.

- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
  - 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
  - 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
  - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

### 3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  - 2. Test the following systems:
    - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
    - b. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - d. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
  - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 4. Test for leaks before applying external insulation.
  - 5. Conduct tests at static pressures equal to maximum design pressure of system or

- section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
1. Visually inspect duct system to ensure that no visible contaminants are present.
  2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
  3. Any liner that shows any evidence of having been wet at any time shall be removed and replaced with new liner.
    - a. Disinfect affected sheet metal, and pins.
    - b. Install new liner per specifications
    - c. Seal friable edges and seams of repaired liner.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.9 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
  2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. General: All lined ductwork is to be increased in size to allow the required amount of insulation.
- B. Outside air/fresh air ductwork shall be wrapped not lined. See section 230700 "Duct Insulation".
- C. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 24.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
    - e. Provide duct liner. See ductwork liner note at the end of this section.
    - f. Round ductwork is to be wrapped with 1 ½ inch 1.5-lb/cut ft with foil cover.
  2. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive 4-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
    - e. Ductwork is to be insulated.
    - f. During the shop drawing review the Pressure class and insulation type and material will be finalized.
- D. Return Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 24.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
    - e. Ductwork is to be lined.
    - f. Round ductwork is to be wrapped with 2 inch thick 1.5-lb/cu. Ft density.
  2. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 3-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
    - e. Ductwork is to be insulated.
    - f. During the shop drawing review the Pressure class and insulation type and material will be finalized.
- E. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 24.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
    - e. Ductwork is to be lined 25 ft upstream from each fan, if the fan is an inline fan

the ductwork shall be line 25 ft upstream and downstream of the fan..

2. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
    - a. Exposed to View: Type 304 18 gauge, stainless-steel sheet, No. 4 finish.
    - b. Concealed: 16 gauge black steel welded.
    - c. Welded seams and joints.
    - d. Pressure Class: Positive or negative 3-inch wg.
    - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
    - f. SMACNA Leakage Class: 3.
    - g. Ductwork is to be wrapped with 2 layers of approved fire wrap that meets ASTM E-2336.
  3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 4-inch wg.
    - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
    - e. During the shop drawing review the Pressure class and insulation type and material will be finalized.
- F. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
  2. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.
- G. Liner:
1. Supply Air Ducts: Fibrous glass, Type I or Flexible elastomeric, 1 inch thick.
  2. Return Air Ducts: Fibrous glass, Type I or Flexible elastomeric, 1 thick.
  3. Exhaust Air Ducts (class I and II): Fibrous glass, Type I or Flexible elastomeric, 1 thick.
  4. Supply Fan Plenums: Fibrous glass, Type II or Flexible elastomeric, 1 thick.
  5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II or Flexible elastomeric, 1 thick.
  6. Transfer Ducts: Fibrous glass, Type I or Flexible elastomeric, 1 inch thick.
- H. Double-Wall Duct Interstitial Insulation:
1. Supply Air Ducts: 1 inch thick or as noted on the drawings.
- I. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
    - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC



Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vaness and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

- J. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows." Longitudinal Seams: Not Allowed, provide spiral round ductwork.
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3- 1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm: 1.5 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches and Larger in Diameter: Welded.
- K. Branch Configuration:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry.  
Rectangular Main to Round Branch: Spin in.

END OF SECTION 233113

## **SECTION 233300 – AIR DUCT ACCESSORIES**

### **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 the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Smoke dampers
5. Fire dampers
6. Turning vanes.
7. Duct-mounted access doors and panels.
8. Flexible ducts.
9. Flexible connectors.
10. Duct accessory hardware.
11. High efficiency take-offs.
12. Concealed damper regulators.
13. Remote damper adjustment

- B. Related Sections include the following:

1. Division 23 Section "Diffusers, Registers, and Grilles."
2. Division 26 Section "Fire Alarm Systems" for duct-mounted fire and smoke detectors.

- C. This division shall demonstrate that all Fire dampers and fire smoke dampers can be maintained and serviced and are operating correctly.

#### **1.3 SUBMITTALS**

- A. Product Data: For the following:

1. Backdraft dampers.
2. Manual-volume dampers.

3. Fire and smoke dampers.
  4. Duct-mounted access doors and panels.
  5. Flexible ducts.
  6. Concealed damper regulators.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
1. Special fittings and manual- and automatic-volume-damper installations.
  2. Fire- and smoke-damper installations, including sleeves and duct-mounted access doors and panels.
- C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

#### 1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
  2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

#### 1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

### PART 2 - PRODUCTS

#### 2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.
- C. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish for ducts exposed to view and mill finish for concealed ducts.
- D. Extruded Aluminum: ASTM B 221, Alloy 6063, Temper T6.

- E. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.2 BACKDRAFT DAMPERS

- A. Description: Suitable for horizontal or vertical installations.
- B. Frame: 0.063-inch- thick extruded aluminum, with mounting flange.
- C. Blades: 0.050-inch- thick aluminum sheet.
- D. Blade Seals: Neoprene.
- E. Blade Axles: Nonferrous.
- F. Tie Bars and Brackets: Aluminum.
- G. Return: Spring with adjustable tension adjustable counter balance.

## 2.3 MANUAL-VOLUME DAMPERS

- A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
  - 1. Pressure Classifications of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- B. Volume Dampers: Dampers smaller than 4 square feet of face area. Multiple- or single-blade, opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
  - 1. Galvanized Steel Frames: Hat-shaped, 16 gauge, Galvanized steel channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
  - 2. Galvanized Steel Blades: Single skin 16 gauge galvanized steel.
  - 3. Blade Axles: Nonferrous.
  - 4. Bearings: Molder synthetic sleeve type.
- C. Jackshaft: 1-inch- diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.
- D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.
- E. Each volume damper concealed above an inaccessible ceiling, etc., shall be provided with a shaft extended through the ceiling, to which shall be attached a chrome-plated or painted Ventlock No. 666 concealed damper regulator. No. 680 Ventlock miter gears shall be used where necessary.

#### 2.4 COMBINATION FIRE-SMOKE DAMPERS

- A. General: Labeled to UL 555S and meeting the code requirements. Combination fire and smoke dampers shall be labeled for one-and-one-half-hour rating to UL 555 for rating assemblies less than 3 hours and three hours for rating assemblies 3 hours or more.
- B. Leakage Rate: Class 1 with less than 8 cfm square foot leakage at 4" w.g. static pressure.
- C. Pressure Rating: Fully operational will velocities to 4000 FPM and pressures in excess of 4" w.g.
- D. Fire Stat: Remotely resettable damper position with switches for remote indication. High Temperature limit returns damper to protection mode when temperature reaches operational limit of damper/actuator assembly.
- E. Frame and Blades: 0.064-inch- thick, galvanized, sheet steel, blades are to be Airfoil.
- F. Mounting Sleeve: Factory-installed, 0.052-inch- thick, unless otherwise indicated, galvanized, sheet steel; length to suit wall or floor application.
- G. Damper Motors: Locate outside air stream unless otherwise indicated. Provide for two-position action.
  1. Electric of voltage to match fire alarm system (coordinate exact voltage). UL listed as part of damper assembly.
  2. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
- H. Provide smoke dampers with two contactor indicators, one for the open position & one for the closed position.
- I. Temperature ratings are to be 250 deg F. Minimum.
- J. Operational Ratings 2000 fpm at 4 in. wg.

- K. Provide a factory mounted single point smoke detector with the Damper. UL Listed S1383. This is not required if a Fire Alarm is provided by division 26.
- L. Provide a testable/resettable switch with each damper.

## 2.5 SMOKE DAMPERS

### A. Ratings:

- 1. Smoke Rating: Leakage Class II Smoke Damper in accordance with UL555S. A Class II smoke damper leaks no more than 20 cubic feet per minute (.57 m<sup>3</sup>/min) at 4 in. wg. (1 kPa) differential pressure.
- 2. Elevated Temperature Rating: 250°F.
- 3. Air Flow Rating: 2000 fpm.
- 4. Pressure Rating: 4 in. wg.

### B. Construction:

- 1. Frame: 5 inches x minimum 16 gage (127 x minimum 1.6 mm) roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gage (2.3 mm) U-channel type frame.
- 2. Blades:
  - a. Style: True airfoil-shaped, single piece, double skin.
  - b. Action: Opposed.
  - c. Orientation: Horizontal.
  - d. Material: Minimum 14 gage (2.0 mm) equivalent thickness, galvanized steel.
  - e. Width: Maximum 6 inches (152 mm).
- 3. Bearings: Self-lubricating stainless steel sleeve, turning in extruded hole in frame.
- 4. Seals:
  - a. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450°F (232°C). Mechanically attached to blade edge (glue-on or grip type seals are not acceptable).
  - b. Jamb: Stainless steel, flexible metal compression type.
- 5. Linkage: Concealed in frame.
- 6. Axles: Minimum ½ inch (13) diameter plated steel, hex-shaped, mechanically attached to blade.
- 7. Mounting: Vertical and/or Horizontal.
- 8. Actuator: Type: Electric 120 V, 60 Hz, two-position, fail close. Mounting: External..
- 9. Finish: Mill galvanized.
- 10. Indicator or Auxiliary Switch Packages: Provide a device attached to the blade or within the actuator to provide damper close status.
- 11. Provide damper momentary test switch factory mounted on damper.
- 12. DSD – Duct Smoke Detector: Factory Mounted. Type: Photoelectronic.

13. Factory Sleeve: Minimum 20 gage (1.0 mm) thickness. Minimum 17 inches (432 mm) long.

## 2.6 FIRE DAMPERS

### A. Curtain type fire dampers.

1. Ratings Fire Resistance: 1½ hours in accordance with UL 555.
2. Dynamic Closure Rating: Dampers shall be classified for dynamic closure to 2000 fpm and 4 inches w.g. (1 kPa) static pressure.

### B. Construction:

1. Integral Sleeve Frame: Minimum 20 gauge roll formed galvanized steel.
2. Blades:
  - a. Style: Curtain type, out of airstream.
  - b. Action: Spring or gravity closure upon fusible link release.
  - c. Orientation: Horizontal.
  - d. Material: Minimum 24 gage (0.6 mm) roll formed galvanized steel.
3. Closure Springs: Type 301 stainless steel, constant force type, if required.
4. Temperature Release Device: 212 degrees F (100 degrees C) fusible link.
5. Mounting: Vertical and/or Horizontal. Duct Transition Connection, Damper Style: Blades out of air stream, high free area.
6. Finish: Mill galvanized.
7. Indicator Switches: Microswitch.
8. Mounting Angles: FAST, 1-1/2 x 1-1/2 inches (38 x 38 mm). Provide steel mullions for dampers in oversized masonry walls. Provide duct breakaway connection in all duct/damper connections.

## 2.7 TURNING VANES

- A. Fabricate single blade vanes to comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible."
- B. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

## 2.8 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Fabricate doors and panels airtight and suitable for duct pressure class.
- B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and

thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

## 2.9 FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.
- C. Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
  - 1. Minimum Weight: 26 oz./sq. yd..
  - 2. Tensile Strength: 530 lbf/inch in the warp, and 440 lbf/inch in the filling.

## 2.10 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1.
- B. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch- thick, glass-fiber insulation around a continuous inner liner.
  - 1. Reinforcement: Steel-wire helix encapsulated in inner liner.
  - 2. Outer Jacket: Glass-reinforced, silver Mylar with a continuous hanging tab, integral fibrous-glass tape, and nylon hanging cord.
  - 3. Inner Liner: Polyethylene film.
- C. Pressure Rating: 6-inch wg positive, 1/2-inch wg negative.
- D. Flexible duct connections from the main trunk ducts to diffuser boots shall be furnished and installed as shown on the drawings. Flexible ducts shall have compression fittings on both ends. Flexible ducts shall connect to trunk duct with high efficiency takeoffs. A balance damper with locking quadrant will be provided downstream of take-off from trunk duct.
- E. Ducts shall conform to the requirements for Class I connectors when tested in accordance with "Standard for Factory Made Air Ducts Materials and Air Duct Connectors" (UL 181). Ducts shall also pass the 15 minute U.L. flame penetration test as specified in the UL 181 Standard.



- F. Flexible ducts shall not extend more than 5'-0". Flexible ductwork shall be run in straight lengths. Flexible ductwork is not allowed to bend 90 degrees. If a bend is needed use sheet-metal hard elbows.
- G. For round ductwork 24" and smaller a True round fire damper with the same rating may be used.

## 2.11 ACCESS DOORS

- A. Provide access doors for visual inspection of fire damper blades.

## 2.12 ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.
- D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
  - 1. Install fusible links in fire dampers.
  - 2. Install duct access doors for inspection of fire dampers.
  - 3. Label fire smoke dampers per the International Fire Code current edition.

Window Rock Office Building and Site  
Construction Documents

- E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
  - 1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
  - 2. Install access panels on side of duct where adequate clearance is available.
- F. Label access doors according to Division 26 Section "Identification for Piping and Equipment."
- G. Where flexible duct is indicated, use insulated flexible duct for supply air return and exhaust air. Flexible ductwork shall only be used as indicated on the drawings and shall not exceed 6 feet. Hard turns, offsets, or kinks will not be allowed. Provide support every three feet.
- H. Use the remote damper operator when they are called out on the drawings or when the damper cannot be easily accessed.

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 23330

## **SECTION 233423 - POWER VENTILATORS**

### **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. Centrifugal roof ventilators.
  - 2. Ceiling-mounted ventilators.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.
- C. Fan Schedule: Fan characteristics and performance data are described in an equipment schedule on the drawings including:
  - 1. Fan arrangement with wheel configuration, inlet and discharge configurations, and required accessories.
  - 2. Capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, shipping weights, operating weights, operating characteristics, and furnished specialties and accessories. Also include the following:
  - 1. Certified fan performance curves with system operating conditions indicated.
  - 2. Certified fan sound-power ratings.
  - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 4. Material thickness and finishes, including color charts.
  - 5. Roof curbs.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required

clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.
  - a. Detail all wiring systems and differentiate clearly between manufacturer-installed and field-installed wiring.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  1. Roof framing and support members relative to duct penetrations.
  2. Ceiling suspension assembly members.
  3. Size and location of initial access modules for acoustical tile.
  4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control Reports

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

#### 1.7 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Belts: One set for each belt-driven unit.

#### 1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Power ventilator electrical components shall comply with applicable NEMA standards.
- D. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.9 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 PRODUCTS FURNISHED BUT NOT INSTALLED

- A. Products furnished, but not installed, under this Section include roof curbs for roof-mounted exhaust fans. Roof curbs to be installed by Division 07, section "Roof Accessories".

2.2 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ACME Engineering & Manufacturing Corporation.
  - 2. Aerovent; a division of Twin City Fan Companies, Ltd.
  - 3. Ammerman; Millennium Equipment.
  - 4. Broan
  - 5. Captive Air.
  - 6. Central Blower Company.
  - 7. Greenheck Fan Corporation.
  - 8. JencoFan.
  - 9. ILG Industries, Inc.
  - 10. Loren Cook Company.
  - 11. PennBarry.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle, square, one-piece, aluminum base with venturi inlet cone.
  - 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain drains.
  - 2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- C. Fan Wheels:
  - 1. Aluminum hub and wheel with backward-inclined blades.
  - 2. Upblast Units: Spark-Resistant Construction: AMCA 99, Type A.

- D. Belt-Driven Units: Motor mounted on adjustable base, adjustable sheaves and with motor and belts within fan housing.
- E. Belt Drives:
  - 1. Resiliently mounted to housing.
  - 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
  - 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
  - 4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
  - 5. Fan and motor isolated from exhaust airstream.
- F. Accessories:
  - 1. Disconnect Switch: Nonfusible type, inside fan housing, factory wired through an internal aluminum conduit.
  - 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
  - 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  - 4. Upblast Units: Grease trough and drain.
- G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base. Provide neoprene gasket between fan base and curb to reduce sound transmission.
  - 1. Configuration: Self-flashing without a cant strip, with mounting flange.
  - 2. Overall Height: 18 inches.
  - 3. Pitch Mounting: Manufacture curb for roof slope.
  - 4. Upblast Units: Vented Curb, Unlined with louvered vents in vertical sides.

### 2.3 CEILING-MOUNTED VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ammerman; Millennium Equipment.
  - 2. Broan-NuTone LLC.
  - 3. Broan-NuTone LLC; NuTone Inc.
  - 4. Carnes Company.
  - 5. FloAire.
  - 6. Greenheck Fan Corporation.
  - 7. Loren Cook Company.
  - 8. PennBarry.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Painted steel grille with flange on intake and thumbscrew attachment to fan housing.

- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

## 2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
- B. Enclosure Type: Open Drip Proof.

## 2.5 FACTORY FINISH

- A. Metal Parts: All assembly parts shall be protected from rust and corrosion.
  - 1. Stainless steel, aluminum, and other non-corroding materials require no protective finish.
  - 2. Non-galvanized sheet metal parts shall be prime coated or powder coated before final assembly.
  - 3. Prime coated parts shall receive baked enamel finish coat after assembly.

## 2.6 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the power ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements. Verify clearances.
- B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and fans have been commissioned.

### 3.3 INSTALLATION

- A. Install power ventilators level and plumb according to manufacturer's written instructions.
- B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- C. Support suspended units from structure using threaded steel rods and **spring hangers** having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Install power ventilators with factory recommended and code required clearances for service and maintenance.
- E. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

### 3.4 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
  - 1. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
  - 1. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.



1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

### 3.7 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
- B. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout."
- C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.
- D. Demonstrate operation of power ventilators. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each power ventilator.

END OF SECTION 233423

## **SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES**

### 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 ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
  - 1. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
  - 2. Division 23 Section "Testing, Adjusting, and Balancing" for balancing diffusers, registers, and grilles.

#### 1.3 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

#### 1.4 SUBMITTALS

- A. Product Data: For each model indicated, include the following:
  - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
  - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
  - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
  - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

- B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for diffusers, registers, and grilles with factory-applied color finishes. Colors to be off-white, unless otherwise selected by Architect during submittal stage.
- D. Samples for Verification: Of diffusers, registers, and grilles, in manufacturer's standard sizes, showing the full range of colors. Prepare Samples from the same material to be used for the Work.

## 1.5 QUALITY ASSURANCE

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated.
- B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Air Factors
  - 2. Krueger
  - 3. Metal Aire
  - 4. Nailor
  - 5. Price
  - 6. Titus
  - 7. Tuttle & Bailey
  - 8. Carnes

### 2.2 REGISTERS, GRILLES, & DIFFUSERS

- A. General: The frames for all registers, grilles, and diffusers shall match type of ceiling where they are to be installed. Special frames shall be provided for narrow T-bar ceilings. Refer to reflected ceiling plan and other specification divisions for ceiling type.

### 2.3 SOURCE QUALITY CONTROL

- A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

### 3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

## SECTION 238143 – HEAT PUMPS

### 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 the following types of heat pumps:
  - 1. Concealed horizontal or vertical units, 8 tons and smaller. (See schedule for configurations.)
  - 2. Refrigerant is to be Puron

#### 1.3 SUBMITTALS

- A. First three paragraphs below are defined in Division 1 Section "Submittal Procedures" as "Action Submittals."
- B. Product Data: Include rated capacities, furnished specialties, and accessories for each model.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- D. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which heat pumps will be attached.
  - 3. Method of attaching hangers to building structure.
  - 4. Size and location of initial access modules for acoustical tile.
  - 5. Items penetrating finished ceiling, including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.

- E. Samples for Verification: For each type of unit indicated.
- F. Product Certificates: For each type of water-source heat pump, signed by product manufacturer.
- G. Manufacturer Seismic Qualification Certification: Submit certification that water-source heat pumps, accessories, and components will withstand seismic forces defined in Division 23 Section "Mechanical Vibration and Seismic Controls." Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- H. Field quality-control test reports.
- I. Operation and Maintenance Data: For water-source heat pumps to include in emergency, operation, and maintenance manuals.
- J. Warranty: Special warranty specified in this Section.

#### **1.4 QUALITY ASSURANCE:**

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC
- B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.
- C. Comply with ASHRAE Standard 90.1-2010, Energy Standard for Buildings except Low-Rise Residential Buildings for cooling and heating performance requirements when tested in accordance with AHRI //210/240//AHRI 340/360// and UL 1995.
- D. Heating Performance shall conform to ASHRAE requirements when tested in accordance with AHRI //210/240//AHRI 340/360// and UL 1995.
- E. Comply with requirements in Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.

**1.5 APPLICABLE PUBLICATIONS:**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specification (Fed. Spec.):
  - A-A-50502-90..... Air-conditioner (UNITARY HEAT PUMP), AIR TO AIR (3000 TO 300,000 BTUH)
- C. Air-Conditioning Heating and Refrigeration Institute (AHRI) Standards:
  - AHRI-DCPP ..... Directory of Certified Product Performance - Applied Directory of Certified Products
  - 210/240-08..... Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment
  - 270-08 ..... Sound Rating of Outdoor Unitary Equipment
  - 310/380-04..... Standard for Packaged Terminal Air-Conditioners and Heat Pumps (CSA-C744-04)
  - 340/360-07..... Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
- D. Air Movement and Control Association (AMCA):
  - 210-07 ..... Laboratory Methods of Testing Fans for Aerodynamic Performance Rating (ANSI)
  - 410-96 ..... Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans
- E. American National Standards Institute (ANSI):
  - S12.51-02 (R2007)..... Acoustics - Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Method for Reverberation Rooms (same as ISO 3741:1999)
- F. American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc (ASHRAE):
  - 15-10 ..... Safety Standard for Refrigeration Systems (ANSI)
  - 62.1-10 ..... Ventilation for Acceptable Indoor Air Quality (ANSI)
  - 90.1-07 ..... Energy Standard for Buildings except Low-Rise Residential Buildings
  - 2008 Handbook..... HVAC Systems and Equipment
- G. American Society of Testing and Materials (ASTM):
  - B117-09 ..... Standard Practice for Operating Salt Spray (Fog) Apparatus



- H. National Electrical Manufacturer's Association (NEMA):  
MG 1-09 (R2010) ..... Motors and Generators (ANSI)  
ICS 1-00 (R2005)..... Industrial Controls and Systems: General Requirements
- I. National Fire Protection Association (NFPA):  
90A-09 ..... Standard for the Installation of Air-Conditioning and Ventilating  
Systems
- J. Underwriters Laboratory (UL):  
1995-05 ..... Heating and Cooling Equipment

**PART II- PRODUCTS**

**2.1 UNITARY HEAT PUMPS, AIR TO AIR**

- A. Units shall comply with Fed Spec A-A-50502 Type II, (Split System) having remote outdoor section separate from indoor Section, Class 1, "Department of Energy" (DOE) covered products (units with cooling capacity up to 65000 Btu/hr).
  - 1. Unitary heat pumps shall bear the United States Environmental Protection Agency, Energy Star label and shall have a minimum Heating Season Performance Factor (HSPF) of 13.0 and a minimum Seasonal Energy Efficiency Ratio (SEER) of 20.
- B. Applicable AHRI Standards: Units shall be listed in the corresponding ARI Directory of Certified products shown in paragraph, APPLICABLE PUBLICATIONS:
  - 1. Air Source Unitary heat pumps with capacity less than 19 KW (65,000 Btu/hr), Comply with AHRI 210/240.
- C. Casing: Unit shall be constructed of zinc coated, heavy-gage galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit surfaces shall be tested 500 hours in a salt spray test in compliance with ASTM B117. Cabinet panels shall have lifting handles and shall be water- and air-tight seal. All exposed vertical, top covers and base pan shall be insulated with 50-mm (2-inch) matt-faced, fire-resistant, odorless, glass fiber material. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2010. The base of the unit shall have provisions for forklift and crane lifting.
- D. Filters: One inch, MERV 7, throwaway filter shall be standard on all units below 19kW (6 Tons). Filter rack can be converted to two inch capability. Two inch, MERV 8, throwaway filters shall be factory supplied on all units above 19 kW (6 Tons).

- E. Compressors: Compressors shall be direct-drive, hermetic scroll type with centrifugal type oil pumps. Motor shall be suction gas-cooled. Internal overloads and crankcase heaters shall be utilized with all compressors.
- F. Refrigerant Circuit: A minimum of two circuits is required. Each refrigerant circuit shall have independent fixed orifice or thermostatic expansion devices, service pressure ports, and refrigerant line filter driers factory installed as standard. An area shall be provided for replacement suction line driers.
- G. Evaporator and Condenser Coils: Internally finned, DN 10 (NPS 3/8) copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. The evaporated coil and condenser coil shall be leak tested at the factory to 1378 kPa (200 psig) and pressure tested to 2756 kPa (400 psig). All dual compressor units shall have intermingled evaporator coils. Sloped condensate drain pans shall be provided.
- H. Outdoor fans: Direct driven, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motors shall be permanently lubricated and shall have built-in thermal overload protection.
- I. Indoor Fan:
  - 1. Forward-Curved, Centrifugal Fan: Provide V-belt driven with adjustable motor sheaves //adjustable idler-arm assembly for quick-adjustment of fan belts and motor sheaves//. Motors shall be thermally protected. Provide oversized motors for high static application. Motors shall meet the U.S. Energy Policy Act of 2005 (EPACT).//
  - 2. Plenum Fans // Provide direct-drive, Arrangement 4, plenum fan(s) equipped with variable-speed drives. Maximum fans in an array shall not exceed four.//
- J. Defrost Controls: A time initiated, temperature terminated defrost system shall ship with a setting of 70-minute cycle, with a choice of 50- or 90-minute cycle. Timed override limits defrost cycle to 10 minutes shall be available on units from 35- to 70-kW (10 to 20 tons). Adaptive demand defrost shall be provided on units below 35 kW (10 Tons).
- K. Unit Electrical
  - 1. Provide single point unit power connection.
  - 2. Unit control box shall be located within the unit and shall contain controls for compressor, reversing valve and fan motor operation and shall have a 50 VA 24-volt control circuit transformer and a terminal block for low voltage field wiring connections.
  - 3. Safety Controls - High pressure, low temperature, and low pressure safety switches shall be wired through a latching lockout circuit to hold the conditioner off until it is reset

electrically be interrupting the power supply to the conditioner. All safety switches shall be normally closed, opening upon fault detection.

L. Operating Controls

1. Provide unit with DDC control system.
2. Low voltage, adjustable room thermostat to control heating and cooling in sequence with delay between stages, compressor and supply fan to maintain temperature setting. Include system selector switch (heat-off-cool) (off-heat-auto-cool) and fan control switch (auto-on).
3. Unit DDC Controller:
  - a. Unit controller shall include input, output and self-contained programming as needed for complete control of unit.
  - b. Unit controller shall be BAC net compliant and utilize BAC net operating protocol.
  - c. Control system shall seamlessly interface with temperature control system as specified in Section 230900, BUILDING AUTOMATION SYSTEM.
  - d. All program sequences shall be stored on board in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of logic controller shall be completely modifiable in the field over installed BACnet LANs.
  - e. Temperature Control System Interface: Points shall be available from the unit controller for service access and display and/or control.
  - f. Space Temperature Sensor: The wall mounted sensor shall include occupied and unoccupied setpoint control, pushbutton unoccupied override, space temperature offset and space temperature indication. Refer to Section 230900, BUILDING AUTOMATION SYSTEM for additional requirements.

M. Accessories:

1. Electric Heater: Constructed of heavy-duty nickel chromium elements. Staging shall be achieved through the unit control processor. Each heater shall have automatically reset high limit control. Heaters shall be individually fused from the factory and shall comply with NEC and CEC requirements. Power assemblies shall provide single point connection. Electric heat modules shall be listed and labeled by a national recognized testing laboratory acceptable to authorities having jurisdiction. Electric heater controls shall confirm the supply fan is operating before electric elements are energized. Operate electric heater in 3stages when outdoor ambient is too low to maintain space thermostat setting with compressor operation.

## 2.2 CORROSION PROTECTION

### A. Remote Outdoor Condenser Coils:

1. Epoxy Immersion Coating – Electrically Deposited: The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be maintained between 0.6-mil and 1.2-mil. Before the coils are subjected to high-temperature oven cure, they are treated to permeate immersion rinse and spray. Where the coils are subject to UV exposure, UV protection spray treatment comprising of UV-resistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty. The coating process shall be such that uniform coating thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:
  - a. Salt Spray Resistance (Minimum 6,000 Hours)
  - b. Humidity Resistance (Minimum 1,000 Hours)
  - c. Water Immersion (Minimum 260 Hours)
  - d. Cross-Hatch Adhesion (Minimum 4B-5B Rating)
  - e. Impact Resistance (Up to 160 Inch/Pound)

### B. Exposed Outdoor Cabinet:

1. Casing Surfaces (Exterior and Interior): All exposed and accessible metal surfaces shall be protected with a water-reducible acrylic with stainless steel pigment spray-applied over the manufacturer's standard finish. The spray coating thickness shall be 2-4 mils and provide minimum salt-spray resistance of 1,000 hours (ASTM B117) AND 500 hours UV resistance (ASTM D4587).

## PART 3- EXECUTION

### 3.1 INSTALLATION

- A. Install heat pumps according to manufacturers printed instructions.
- B. Install electrical and control devices furnished by the manufacturer but not specified to be factory mounted. All electrical work shall comply with Division 26 Sections.
- C. Ductwork: Comply with requirements in Section 23 31 13, METAL DUCTS.
- D. Piping: Comply with requirements in Division 23.

### **3.2 STARTUP AND TESTING:**

- A. Perform startup checks according to manufacturer's written instructions.
- B. Test controls and demonstrate its compliance with project requirements. Replace damaged or malfunctioning controls and equipment and retest the equipment to the satisfaction of the Resident Engineer.
- C. Furnish test reports to the Senior Resident Engineer in accordance with specification in Division 1, and Section 23 05 94 GENERAL TESTING, ADJUSTING, BALANCING AND COMMISSIONING.

### **3.3 INSTRUCTIONS**

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of heat pumps.

### **3.4 STARTUP AND TESTING**

- A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

### **3.5 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 05 50 – OPERATIONS AND MAINTENANCE MANUALS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 05 94 GENERAL TESTING, ADJUSTING, BALANCING AND COMMISSIONING and related sections for contractor responsibilities for system commissioning.

### **3.6 DEMONSTRATION AND TRAINING**

Window Rock Office Building and Site  
Construction Documents

- A. Provide services of manufacturer's technical representative for four hours to instruct VA personnel in operation and maintenance of units.
- B. Submit training plans and instructor qualifications in accordance with the requirements of of Section 23 05 50 – OPERATIONS ND MAINTENANCE MANUALS.

END OF SECTION 238143

SECTION 31 00 00 - EARTHWORK

PART 1 - GENERAL

1.0 SECTION INCLUDES

- A. This Section includes all excavating, placing, filling, backfilling, compacting and grading at the site shown on the drawing and specified herein, including the following:
  - 1. Provide Horizontal and Vertical control Staking.
  - 2. Provide excavation, rough grading, subgrade preparation, overlotting, filling, backfilling, compaction and disposal of spoil material as shown on the drawings to meet line and grade specified herein, or as specified to complete the work. Legally haul and dispose of all spoil material.
  - 3. Material excavated shall be defined as "unclassified excavation" and shall include all excavation performed under this item regardless of the material encountered, except for contaminated material requiring special handling and disposal.
- B. Related Requirements:
  - 1. Section 31 11 00: Clearing and Grubbing
  - 2. Section 31 23 17: Trenching
  - 3. Section 32 13 13: Concrete Paving.

1.1 REFERENCES

- A. American Association of State Highway and Transportation Office (AASHTO)

1.2 DEFINITIONS

- A. Excavation: The term "excavation", as used herein, consists of removal of material encountered to subgrade or over-excavation elevations indicated, and subsequent disposal or placement of materials removed.
- B. Unauthorized Excavation: The term "unauthorized excavation", as used herein, consists of inadvertently or purposely removing materials beyond indicated subgrade elevations or dimensions without specific direction of the Engineer. Unauthorized excavation as well as remedial work resulting from unauthorized excavation, as directed by the Engineer, shall be at Contractor's expense.
  - 1. Backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the Engineer.
  - 2. Unauthorized excavation, including deposition of additional excavated materials and other work resulting from slides, cave-ins or remedial work, shall be at Contractor's expense.
- C. Subgrade: The term "subgrade", as used herein, designates the undisturbed earth or the compacted soil layer immediately below proposed foundations and slabs.
- D. Structure: The term "structure," as used herein, refers to retaining walls, buildings, tanks, or other manmade stationary features occurring above or below ground surface.
- E. Unclassified Excavation: The term "unclassified excavation," as used herein, includes the excavation of all materials required for the work obtained within construction limits of project, including bedrock, boulders, wasted sections of concrete, asphalt or other debris.

Window Rock Office Building and Site  
Construction Documents

1. The contractor should review the geotechnical report prepared by Iron Rock Engineering for further information.
- F. Fill: The term "fill," as used herein, includes on-site and imported materials placed in order to raise the grade above existing contours.
- G. Backfill: The term "backfill," as used herein, includes on-site and imported materials placed in authorized or unauthorized excavations.
- H. Foundations: The term "foundations," as used herein, refers to footings, foundation walls and any other support placed directly on soil.
- I. Topsoil: The term "topsoil," as used herein, refers to surface soil approximately 6- inches in depth that support growth of vegetation and contains organic matter. Topsoil shall be free from subsoil, debris, and stone larger than 1- inch in diameter.

### 1.3 SUBMITTALS

- A. Certificates and Testing for the following:
  1. In-place density tests for compacted subgrade material, fill, and backfill used.
  2. Subgrade soil inspection results.
  3. Independent laboratory analysis of aggregate base course, granular backfill, and/or any material proposed for use as fill or backfill. Report shall include optimum moisture content and maximum density of all materials to be compacted.

### 1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with all applicable local, state and Federal rules, regulations and ordinances concerning sloping of excavation, trenching and safety of workers, including the latest OSHA requirements.
- B. Testing and Inspection Service: The Contractor shall employ and pay for a qualified independent geotechnical testing and inspection laboratory to perform soil testing and inspection service during earthwork operations; Contractor shall provide necessary means to assure cooperation with testing firm.
- C. Special Inspection: Special Inspection is required as per the requirements set forth in the International Building Code (IBC) 2009, Section 17.
- D. Verify that finished grade and slopes are within 0.1 ft. of grades indicated. Any conditions indicating a failure must be corrected, including, but not limited to:
  1. Formation of pools of moisture where positive drainage is indicated on the drawings.
  2. Settlement of fill.
  3. Flow of moisture toward, or entrapment against, building foundations.

### 1.5 PROJECT CONDITIONS

- A. Site Information: Test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration. Obtain Owner's approval of test site, and return area to original condition.



- B. Borrow Sources: Any off-site fill used in the construction of the facility must be weed free.
- C. Heavy equipment to be used for project construction is required to be free of weed seeds, stems or flowers prior to being brought on site.
- D. Stripped material consisting of vegetation and organic materials may be used to re-vegetate landscaped areas or exposed slopes after completion of the grading operations, upon approval of the Engineer.
- E. A representative of the Owner should observe the site clearing and preparation to determine if any buried obstacles are present.

## PART 2 - PRODUCTS

### 2.0 SOIL MATERIALS

- A. General: All fill material, regardless of intended use category, must be clean and free from organic matter, roots, brush or other vegetation, trash, brick, debris, frozen material, or other detrimental substances, and rocks or unbroken lumps larger than 3 inches, and must be tested and approved by the testing agency prior to placement.
- B. On-Site Materials: On-site soil consisting of sand which is free of clay, meeting the requirements of Part A above, and is approved by the testing agency may be used as fill material.
- C. Structural Fill: Structural fill may be imported or on-site material. It shall be non-plastic granular soil with no more than 25 percent passing the No. 200 sieve.
- D. Base Course Material: Base course material shall be a clean, free-draining sand, gravel or crushed rock. It shall meet the requirements of Part A above, be approved by the testing agency and have the following properties:

<u>Sieve Size</u>	<u>% Passing</u>
1"	100
3/8"	30-100
No. 200	0-10

- E. Sand: Clean, natural sand.

## PART 3 - EXECUTION

### 3.0 PREPARATION

- A. Protection:
  - 1. Protect existing surface and subsurface features on site and adjacent to site as follows:
    - a. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
    - b. Protect and maintain bench marks, monuments or other established reference points and property corners. If disturbed or destroyed, replace at Contractor's expense to full satisfaction of the Owner.

- c. Verify location and existence of utilities. Omission or inclusion of utility items does not constitute non-existence or definite location. Secure and examine local utility records for location data.
    - 1) Take necessary precautions to protect existing utilities from damage due to any construction activity. Repair damages to utility items at Contractor's expense.
    - 2) Active Utilities: Do not interrupt existing utilities serving facilities occupied and used by adjacent properties, except when permitted in writing by the local utility company, and then only after acceptable temporary utility services have been provided. Remove or relocate utilities only as indicated or specified.
    - 3) Inactive Utilities: Report inactive or abandoned utilities encountered in excavating or grading operations, and remove, plug, or cap as required. In the absence of specific requirements, plug or cap such utility lines as required by local rules or regulations.
  - d. Maintain roadways, sidewalks, curbs, gutter, structures and pavement free of damage. Any damaged items shall be repaired to original condition at Contractor's expense.
  - e. Provide full access to public and private premises, fire hydrants, access roads, sidewalks and other points to prevent serious interruption of travel.
  - f. Maintain stockpiles and excavation in such a manner to prevent inconvenience or damage to structures on site or on adjoining property.
  - g. Avoid surcharge or excavation procedures which can result in heaving, caving or slides.
2. Protection of Structures: Prevent new and existing structures from becoming damaged due to construction operations or other reasons. Prevent subgrade under new and existing foundations from becoming wet or undermined during construction due to the presence of surface or subsurface water and/or construction operations.
  3. Frost Protection:
    - a. Do not place foundations or fill material on frozen ground.
    - b. When freezing temperatures may be expected, do not excavate to full depth indicated unless foundations or fill material can be placed immediately after excavation has been completed and approved.
    - c. Protect excavation from frost if placing of concrete or fill is delayed.
    - d. Protect subgrade under foundations from becoming frozen until structure is completed.
- B. Dust Control: Provide dust control as required to alleviate dust nuisance to adjacent properties.
- C. Erosion Control: Provide erosion control methods in accordance with requirements of authorities having jurisdiction. The Erosion Control measures shall be implemented throughout the construction period in order to protect adjacent properties, streets, and storm sewers from erosion and sediment deposition. Do not commence excavation and grading work until erosion control measures are in place. Contractor shall be responsible for daily monitoring, cleaning, and other work required for proper operation. Contractor shall modify/replace all erosion control measures to fit field conditions or as directed by the Owner.

- D. Unanticipated Conditions: Notify the Owner immediately upon finding evidence of previous structures, filled materials which penetrate below designated excavation levels, or other conditions which are not shown or which cannot be reasonably assumed from existing surveys and geotechnical reports. Secure the Owner's instruction before proceeding with further work in such areas.
- E. Revegetation and Soils conservation: Revegetate all areas disturbed by construction which are not paved, landscaped or occupied by structures, using the same species and in the same density and proportions as found on site prior to disturbance. Use the following revegetation methods:
  - 1. Remove (scrape) vegetation and topsoil from the smallest usable space necessary within the project area. Leave small "islands" of native vegetation intact within close proximity to one another and to structures, to facilitate natural revegetation.
  - 2. Stockpile and cover all topsoil removed. Stockpiled material containing a viable native seed bank should be evenly distributed over the open areas within one year.
  - 3. Prior to topsoil application, rip the open areas, to decrease soil compaction and increase water infiltration.
  - 4. Augment revegetation using one or more of these options: 1) Collect native grass, forb, and shrub seed adjacent to the project site and directly sow them to prepare sites; 2) Grow native plants for outplanting at the project site to supplement seeded areas or for areas where seedling establishment is inadequate.
  - 5. Apply a mulch to newly seeded or planted areas which is made by chipping native vegetation that has been removed from the project site.
  - 6. Water weekly until winter precipitation is sufficient.

### 3.1 EXCAVATION

#### A. General:

- 1. Prior to any construction, topsoil, vegetation, construction debris, and fill material should be stripped and cleared from the site.
  - a. This may require the removal of the top 8 inches of material prior to construction and additional grubbing to remove the large bush roots.
  - b. All exposed surfaces should be free of mounds and depressions, which could prevent uniform compaction.
- 2. Perform excavation as required by the Drawings to the subgrade elevations indicated.
- 3. Minimize disturbance of natural soils at subgrade.
- 4. Where solid rock is encountered in excavation, it shall be loosened and broken up such that no solid ribs, projections, or large fragments will be within 6" of the final subgrade.
- 5. When excavation has reached required subgrade elevations, have the independent geotechnical testing and inspection laboratory make an inspection of conditions. If tests determine that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and backfill overexcavation as directed by testing and inspection laboratory.
- 6. Place foundations or backfill as soon as possible after excavation is completed, inspected, and approved.
  - a. Until concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen or soft due to weather, construction operations or other reasons.
- 7. Use of explosives: Blasting with any type of explosive is prohibited.

#### B. Subgrade Stabilization:

1. If subgrade under foundations or fill material exhibits pumping during proof-rolling, or is, or becomes, frozen, loose, wet, or soft before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted granular material as directed by the independent geotechnical laboratory.
  2. Use of lime, fly ash, kiln dust, cement or geotextiles could also be considered as stabilization techniques. Laboratory evaluation is recommended to determine the effect of chemical stabilization on subgrade soils prior to construction.
  3. Lightweight excavation equipment may also be required to reduce subgrade pumping.
  4. Where structural fill is required below the subgrade elevation of footing, extend structural fill 1 foot horizontally beyond the edge of the footing for each 1 foot thickness of fill.
  5. Provide compaction density of replacement material as specified for the effected area.
  6. Do not place further construction on the repaired subgrades until the repairs have been approved.
- C. Shoring: Shore, slope, or brace excavations as required to prevent them from collapsing. Remove shoring as backfilling progresses but only when banks are stable and safe from caving or collapsing.
- D. Drainage and Dewatering:
1. During construction, control grading so that ground is sloped to prevent water from running into excavated areas or damaging existing structures.
  2. Where foundations or fill material are to be placed, maintain excavations free of water.
  3. Provide dewatering as required to keep excavated spaces clear of water during construction:
    - a. Should groundwater water be encountered, notify Owner.
    - b. Where groundwater is or is expected to be encountered during excavation, install dewatering system to prevent softening and disturbance of subgrade and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope.
    - c. Review soils investigation before beginning excavation and determine if and where groundwater is likely to be encountered during excavation.

### 3.2 FILL AND BACKFILL

- A. General:
1. Subgrade to receive fill or backfill shall be stripped of vegetation, debris, organic matter, and free of undesirable material.
  2. Prior to fill placement, the exposed native soils should be scarified to a minimum depth of 8", conditioned to near optimum moisture content, and compacted. Surface may be stepped by not more than 12 inches per step or may be sloped at not more than 20%. Plow or break up steeper sloped surfaces so that fill material will bond with existing surface.
  3. Do not place fill or backfill when fill material is frozen or when subgrade is frozen, wet, loose, or soft.
  4. Obtain approval of fill and backfill material, as well as optimum moisture and maximum density properties for proposed materials, from independent geotechnical laboratory prior to placing the material.
- B. Fill: Construct embankments and fills as required by the Drawings.

1. Construct embankments and fills at locations and to line and grade indicated. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
2. Provide fill material meeting the requirements of Part 2. Do not place material in layers greater than 8 inches loose thickness where compacted by heavy equipment, nor 4 inches where compacted by hand-operated tampers. Place layers horizontally and compact each layer prior to placing additional fill.
3. Compact by sheepsfoot, pneumatic rollers, vibrators, or by other equipment as required to obtain specified density. Control moisture for each layer as necessary to meet requirements of compaction.

C. Backfill:

1. Provide on-site fill material meeting the requirements of Part 2. Do not place material in layers greater than 8 inches loose thickness where compacted by heavy equipment, nor 4 inches where compacted by hand-operated tampers. Place layers horizontally and compact each layer prior to placing additional fill.
2. Compact material by means of equipment of sufficient size and proper type to obtain specified density. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors.
  - a. Use vibratory equipment to compact granular material, do not use water.
  - b. Control moisture for each layer of on-site material as necessary to meet requirements of this section.
3. Place fill evenly on each side of grade beams or provide bracing.

D. Interior Slab-on-Grade and Entryways: Prepare subgrade at slabs-on-grade in accordance with the following.

1. Scarify, moisture condition, and compact subgrade to a minimum depth of 8 inches.

E. Exterior Slab-on-Grade / Site Concrete: Prepare subgrade at slabs-on-grade in accordance with the following.

1. The upper 18 inches of the native subgrade soils are to be removed and replaced with imported granular non-plastic fill with less than 10 percent fines content.

### 3.3 COMPACTION

A. General:

1. Extent of compaction testing will be as necessary to assure compliance with Specifications. Such testing will be performed by an independent geotechnical testing and inspection laboratory employed by the Contractor and qualified to perform such work.
  - a. Tests shall be performed at locations as directed by independent geotechnical laboratory.
  - b. Testing laboratory personnel are to be on site during continuous backfill and compaction operation.
2. Moisture density relations are required for all materials that are to be compacted prior to commencing compaction.

B. Subgrade Inspection:

1. Notify independent geotechnical laboratory as soon as excavation is completed in order that subgrades may be inspected.
2. Do not commence further construction until subgrade has been inspected and approved as being free of undesirable material, being of compaction density specified in this Section,

and being capable of supporting the allowable design bearing pressure and superimposed foundation, fill and structure loads to be placed thereon.

3. Remove frozen, loose, wet or soft material and replace with approved material as directed by independent geotechnical laboratory.

C. Compaction and Density Requirements:

1. Perform compaction of soils and all work associated with that effort with equipment designed for, and suitable to provide the compaction required.
2. Provide and maintain dewatering as necessary to meet compaction requirements.
3. Assure by testing that the compaction densities comply with the following requirements:

**Location**

Below foundations  
and slabs and

**Compaction Density**

95% of maximum dry density (AASHTO T180)  
within 2% of optimum moisture content.

3.4 GRADING

- A. General: Uniformly grade areas within project limits, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations or contours are indicated or between such points and existing grades.
- B. Grade areas adjacent to structures to drain away from structures with a minimum fall of 5 percent for at least 5 feet from perimeter walls where sidewalks or paving do not immediately adjoin the structure.
- C. Verify compaction of graded areas to depths and densities specified.

3.5 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. Waste materials, including materials not allowed for fill, backfill or site grading as specified, trash, and debris, shall be removed from the project site and legally disposed of offsite.

3.6 MAINTENANCE

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.
- D. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface, add backfill material, and compact. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 31 00 00

## SECTION 31 11 00 - CLEARING AND GRUBBING

### PART 1 - GENERAL

#### 1.0 SUMMARY

- A. Section Includes: Clearing of vegetation, and grubbing of stumps, roots, and debris; disposal of unutilized materials; and other incidental work related to preparing the site for later use.

#### 1.1 DEFINITIONS

- A. Clearing: Clearing shall consist of the felling, trimming, and cutting of obstructions such as trees into sections and the satisfactory disposal of the trees and other surface vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.
- B. Grubbing: Grubbing shall consist of the removal and disposal of below-surface stumps, roots larger than 75 millimeters (3 inches) in diameter, and matted roots from the designated grubbing areas.
- C. Hazardous Waste: Substance likely to cause death or injury by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, or otherwise harmful; and includes, but is not limited to flammable dust, flammable fiber, combustible liquid, dangerous chemical, flammable gas, liquefied flammable gas, and flammable liquid.

#### 1.2 PROJECT/SITE CONDITIONS

- A. Work Limits: Refer to Contract Documents for limits of construction. The areas to be cleared and grubbed shall be staked out by the Contractor. Scalping of topsoil during clearing operations will not be permitted.
- B. Burning of Slash: Shall not be permitted.
- C. Landscape Preservation: Protect vegetation outside the work limits from injury. Existing trees and shrubs shall not be disturbed or damaged.
- D. Excess Materials: Arrange for disposition of unsuitable materials, waste materials, and materials not allowed by specifications for fill, backfill, or site grading in accordance with local requirements. Location of dump, length of haul, and disposal expenses are Contractor's responsibility.
- E. Contractor shall provide dust control watering as needed to control dust emissions.

### PART 2 – PRODUCTS

NOT USED

### PART 3 – EXECUTION

### 3.0 PROTECTION

- A. Clearing: Areas to be graded shall be cleared and grubbed of all vegetation and debris. These materials shall be removed from the site by the Contractor.
- B. Demolition: All existing structures, if present, including buried obstacles, pavements, nonfunctional utilities, foundations, and other such items or structures, shall be removed from the site or moved to a local location as directed by the Contracting Officer. Subsurface structures, if found, shall be fully excavated and removed, loose material in the excavation shall be compacted, and the excavation backfilled with properly compacted soils. A representative of the Geotechnical Engineer should be present to observe the site clearing and preparation to determine if any buried obstacles are present.
- C. Stripping: Surface soils containing roots and organic matter shall be stripped from areas to be graded and stockpiled or discarded as directed by the Contracting Officer. Prior to any construction, topsoil, vegetation, construction debris and fill material should be stripped and cleared from the site. In general, the depth of stripping and removal of the surface material will be from 4 to 6 inches. Deeper stripping and grubbing, where required to remove weak soils or accumulations of organic matter including large bush roots, shall be performed when determined by the Geotechnical Engineer. All exposed surfaces should be free of mounds and depressions, which could prevent uniform compaction. All stripping material shall be removed from the site or stockpiled at a location designated by the Contracting Officer.
- D. Removal of Existing Fill: Existing fill soils, trash, and debris in the areas to be graded shall be removed prior to the placing of any compacted fill. Portions of any existing fills that are suitable for use in compacted fill may be left in place if in a proper location or stockpiled for future use. All organic material, topsoil, expansive soils, oversize material or other unsuitable material shall be removed from the site by the Contractor or disposed of at a location on site, if so designated by the Contracting Officer. No large rocks or boulders should be encountered.
- E. Ground Surface: The ground surface at the building construction site is generally a loose to medium dense silty to clayey sand fill with some areas of sand lenses intermixed. Compaction of disturbed soils is recommended by the geotechnical engineer to occur in lifts, the soils shall be brought to within  $2\% \pm$  of optimum moisture content and compacted to 96% of maximum dry density. No special excavation equipment is considered to be necessary for the site soils. In those areas where significant fill is required, recompaction shall be approved by the Geotechnical Engineer prior to placing fill.
- F. Roads: Keep existing roads free of dirt and debris at all times. A vehicle tracking pad at the entry road into the site near the proposed gate across the existing access aggregate road is required until pavement is placed.
- G. Trees and Shrubs: Trees shall be felled into the area being cleared when ground conditions, tree lean, and shape of clearing permit. Controlled felling shall be used that will ensure the direction of fall when necessary to prevent damage to property, structures, trees designated to remain, or traffic. All felled trees and shrubs shall be removed from the site or stockpiled at a location designated by the Contracting Officer.
- H. Utility Lines: Protect existing utility lines that are indicated to remain from damage. Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility



line. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to the start of clearing and grubbing operations. When utility lines, which are to be removed, are encountered within the area of operations, the Contractor shall notify the Contracting Officer 72 hours prior to interruption of the service.

### 3.1 CLEARING

- A. Requirements: Clear, roots, brush, and other vegetation in areas to be graded; cut off flush with or below the original ground surface, except such vegetation indicated or directed to be left standing. Vegetation, if any, to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

### 3.2 GRUBBING

- A. Requirements: Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes shall be removed to match the surrounding surface. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground. Non-organic, natural debris not suitable for foundation purposes shall be removed or placed into fill slopes.
- B. Low Embankment Areas: When the finished subgrade is less than 1 m (3 feet) above the original ground, remove stumps, roots, and debris to a minimum of 150 mm (6 inches) below the original ground. Backfill stump and root holes with approved material and compact before placing embankment material.
- C. High Embankment Areas: When the finished subgrade is 1 m (3 feet) or more from the original ground, stumps may be cut flush and left in place. Removal of undisturbed stumps and roots and nonperishable solid objects will not be required.

### 3.3 EXPLOSIVES

- A. Use of explosives is prohibited.

### 3.4 DISPOSAL

- A. Requirements: Material that is not to be salvaged shall be removed from the project site and legally disposed of offsite. Burning will not be permitted.

END OF SECTION 31 11 00

## SECTION 31 23 17 - TRENCHING

### PART 1 - GENERAL

#### 1.0 SUMMARY

- A. Section Includes: Trenching, backfilling, and compacting for the installation of utility lines.

#### 1.1 DEFINITIONS

- A. Unclassified Excavation: Shall consist of the material excavated and its placement, regardless of its nature.
- B. Rock Excavation: Removal of material shall be considered rock excavation when it consists of igneous, metamorphic, and sedimentary rock which cannot be excavated without blasting or the use of a tractor having a power rating in excess of 195 net hp, with a rear-mounted, heavy-duty, single-tooth ripping attachment.
- C. Common Excavation: Removal of materials which can be excavated using a rear-mounted, heavy-duty, single-tooth, ripping attachment mounted on a crawler tractor with a power rating of 195 net hp or less shall be considered common excavation.
- D. Muck Excavation: Shall consist of the removal and disposal of deposits of saturated or unsaturated mixtures of soils and organic matter not suitable for foundation material regardless of moisture content.
- E. Fill Material: Shall be mineral soil, free from peat, frozen material, brush, trees, roots over 50 mm (2 inches) in diameter and rocks over 150 mm (6 inches) in greatest diameter obtained from the site during excavation.
- F. Topsoil: Surface soil, approximately 150 mm (6 inches) in depth that supports growth of vegetation and contains organic matter. Topsoil shall be free from subsoil, debris, and stones larger than 25 mm (1 inch) in diameter.

#### 1.2 QUALITY ASSURANCE

- A. Failure Criteria: Not limited to the following:
  - 1. Settlement of backfill below natural ground surface.
  - 2. Evidence of leakage of the piping.
  - 3. Malfunctioning of buried electrical or piping systems.
- B. Applicable Standards: Apply the current or latest editions of the standards described below:
  - 1. ASTM - American Society for Testing and Materials
  - 2. AASHTO - American Association of State Highway Officials

#### 1.3 PROJECT AND SITE CONDITIONS

- A. Borrow Sources: Shall be as approved by the Contracting Officer prior to excavation. Local clay, silty clay, silts or sands must be approved as borrow materials by the geotechnical engineer or the Contracting Officer. Compaction of this material must include moisturizing to within 2 percent of optimum moisture.
- B. Environmental Conditions:

1. Excavate areas that have become saturated with oil, gasoline, or bituminous products to a depth of 300 mm (12 inches) beyond contaminated materials; backfill with approved material.
2. Finish slopes according to the drawings. Hand rake as necessary to remove excess material in areas inaccessible to construction equipment. The existing surface generally is well drained and care must be taken to maintain the natural slopes and sheet flow drainages.

## PART 2 - PRODUCTS

### 2.0 MATERIALS

- A. General: Material excavated shall be considered unclassified and must be conditioned prior to compaction as described in Section 1.04.A above.
- B. Fill Material: Shall be approved before use. Material from excavations shall be used, unless it contains ice or frozen earth, debris, high moisture content, or is specified in other sections to be replaced. Materials removed in clearing and grubbing shall not be used for backfill. Backfill shall not contain rock larger than 3 inches in diameter.
- C. Crushed Rock Backfill:
  1. Aggregates for backfill shall be crushed stone, crushed slag, crushed gravel, natural gravel, or crushed reclaimed concrete or asphalt material which conforms to the quality requirements of AASHTO M 147 except that the requirements for the ratio of minus 75 m (No. 200) sieve fraction to the minus No. 40 sieve fraction, stated in 2.2.2 of AASHTO M 147, shall not apply. The requirements for the Los Angeles wear test (AASHTO T 96) shall apply.
  2. Gradation requirements:

<u>Sieve Size</u>	<u>Mass Percent Passing Sieve Square Mesh Sieves LL not greater than 30</u>
37.5 mm (1 1/2")	100
25.0 mm (1")	95-100
4.75 mm (# 4)	30-70
4.75 um (#200)	3-15

- D. Well Graded Sand Bedding: Shall be clean granular material free of clay and organic material. 90% to 100% shall pass a No. 4 sieve and not more than 5% shall pass a No. 200 sieve.
- E. Granular Bedding: Well graded mixture of sound mineral aggregate which will provide good stability, ranging in size from 1/4" minimum to 3/4" maximum, with the maximum amount of fines passing a No. 8 screen not to exceed 10% by weight, and complying with ASTM C 33 and D 448.
- F. Granular bedding shall not be used on plastic pipe installation.
- G. Existing On-Site Material: Fines from trench excavation and spoil piles may be used to support pipe, provided that no rocks or stones larger than that allowed by sieve analysis for granular bedding material, or other detrimental matter, is placed closer to the pipe than 6".

- H. Bedding shall have a minimum depth of 6” below the pipe, including bells.
- I. Backfill: Backfill shall be classified as all material within the remainder of the trench. Backfill shall conform to the following gradation:

<u>Passing Sieve Designation</u>	<u>Percentages By Weight Square Mesh Sieves (AASHTO T 27 &amp; T 11)</u>
3-inch	100
No. 4	100
No. 30	20-100

- J. Identification Warning Tapes Above Pipes: Identification tapes shall be placed per the Kane County’s Utilities Department or other Utility Company or District requirements.

### PART 3 - EXECUTION

#### 3.0 PREPARATION

- A. Clearing: Maximum clearing width is 120 cm (4 feet) on each side of the trench. Provide minimum disturbance to existing grass and sod. Dispose of debris on site.
- B. Topsoil: Strip topsoil to a depth of 10 cm (4 inches) of surface material and store in designated stockpile areas. In the absence of topsoil, do not disturb the underlying hardened soils. Do not excavate into the underlying, original topsoil at stockpiles. Place previously stripped topsoil onto disturbed-earth areas upon completion of the backfilling operation.
- C. Utilities: Before starting excavation, establish the location and extent of underground utilities in the work area. Protect active utility services uncovered by excavation. Notify the Contracting Officer immediately if utilities are damaged. Damage to utilities shall be repaired or replaced at the Contractor's expense.
- D. Protection of Excavation: Construct and maintain shoring, bracing, underpinning, and sheet piling necessary to protect the excavation. Remove protection devices when safe to do so, or as authorized by the Contracting Officer. Portions wholly buried by earth and at a distance of at least 45 cm (18 inches) from permanent structures may be left in place in the completed work. The exposed portion of the sheeting and shoring must be removed before completing the backfill.
- E. Dewatering: Keep the excavation dewatered so that pipe, forming, and concrete work can be carried on under dewatered conditions. Dispose of excess water by using natural drainageways near the site to the extent of their natural capacity, when no erosion or other damage will ensue.

#### 3.1 INSTALLATION

- A. General:
  - 1. Restore disturbed areas of existing bituminous pavements.
  - 2. Do not install bedding material above water, electrical, and sewer systems until system testing is completed and approval granted by the Contracting Officer.

- B. Trench Excavation: Shall be as shown on the drawings and each utility shall be placed at least to the following depth minimums to top: Electrical at 92 cm (3 feet) below natural ground; Sanitary pipe and force main at 92 cm (36 inches); Water main at 183 cm (72 inches); Gas main at 122 cm (48 inches). Excavate trenches in rock to a depth of at least 100 mm (4 inches), but not exceeding 300 mm (12 inches), below pipe bottom.
1. When over-excavation occurs, repair the area by backfilling with approved bedding material and compacting to 96 percent maximum dry density according to AASHTO T 99, Method D.
  2. When frost action occurs, remove frozen soil and replace with approved soil compacted to 95 percent of maximum dry density as determined by AASHTO T 99, Method D.
  3. When soil becomes saturated above the optimum moisture content, compact after it has dried, or remove soil down to firm material and place backfill before construction proceeds.
- C. Removal of Existing Materials by Explosives: The use of explosives for utility trenching is to be used only as a last resort and shall be carried out by Contractor or Contractor's subcontractor who is certified by the State of Utah in use of explosives for excavation work. Techniques to use only the minimum amount of explosives to accomplish the removals shall be employed at all times. Utility lines may be nearby areas where blasting may be required.
- D. Bedding: Shall be placed in 8 inch maximum loose lifts. Bedding shall extend 6 inches below the lowest utility to 6 inches above the highest utility. Moisture content of bedding material shall be within 2% of optimum. Compact to 95 percent maximum dry density as determined by AASHTO T 99, Method D.
- E. Trench Backfill: After testing and approval of interconnected piping systems, the trench backfilling shall be completed. Puddling or flooding of trench for consolidation of backfill or use of wheel rolling by construction equipment will not be permitted.
1. Provide uniform and continuous support for each section of pipe. Place backfill in 150 mm (6-inch) maximum loose lifts to a depth of 300 mm (1 foot) over the top of the pipe. Compact to 95 percent maximum dry density as determined by AASHTO T 99, Method D. Prevent lateral displacement or deformation of piping during compaction.
- F. Protection Of Existing Utilities: The location of existing utilities is shown in an approximate way only and not all utilities may be shown. The Contractor shall determine the exact location of all existing utilities prior to commencing work. The Contractor shall be fully responsible for any and all damages which might be occasioned by his failure to exactly locate and preserve any and all utilities. If utilities are to remain in place during construction, the Contractor shall provide adequate means of support and protection. The Contractor shall maintain access to public and private properties, to fire hydrants, and to sidewalks as required.
- G. Surface Restoration: All surface cuts shall be, as a minimum, restored to a condition equal to that prior to construction. All streets shall be restored in accordance with the regulations and requirements of the agency having control or jurisdiction over the street, roadway or right-of-way.

### 3.2 FIELD QUALITY CONTROL

Window Rock Office Building and Site  
Construction Documents

- A. Testing: Testing shall be conducted in the presence of the Contracting Officer, who shall be given 48 hours notice before any test is to be conducted. Arrange for a certified, independent testing laboratory to perform required laboratory testing services, recording, and distributing of the results.
- B. Testing of Pipe Lines: Pipe testing shall be conducted under the supervision of the utility district that will take the utility after testing or in the future as a public utility. Testing of utility lines that will not be taken as public lines shall be done according to Section 02518 - Testing of Piping Systems.

END OF SECTION 31 23 17

## SECTION 32 01 13 - SLURRY SEAL

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Stone and paving asphalt slurry evenly spread as a roadway surface treatment.

#### 1.2 REFERENCES

- A. ASTM C 88: Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.
- B. ASTM C 117: Standard Method of Test for Amount of Material Finer Than 0.075 mm Sieve in Aggregate.
- C. ASTM C 131: Standard Test Method for Resistance to Degradation of Small-Size coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- D. ASTM C 136: Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- E. ASTM D 242: Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
- F. ASTM D 1664: Standard Test Method for Coating and Stripping of Bitumen-Aggregate Mixtures.
- G. ASTM D 2419: Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- H. ASTM D 3319: Standard Test Method for Accelerated Polishing of Aggregates Using the British Wheel.
- I. ASTM D 3628: Standard Practice for Selection and Use of Emulsified Asphalts.
- J. ASTM D 3910: Standard Practices for Design, Testing, and Construction of Slurry Seal.
- K. ASTM D 5821: Standard Test Method for Determining the percentage of Fractured Particles in Coarse Aggregate.

#### 1.3 SUBMITTALS

- A. Traffic control plan, Section 01 55 26.
- B. Mix Design: 10 days prior to use, submit proportions of aggregate, filler, water and emulsions in the mix.
- C. Equipment: Submit list of construction equipment to be used.
- D. Asphalt Bill of Lading: Identify.
  - 1. Weight of asphalt.
  - 2. Weight of emulsified asphalt (after water has been added).
  - 3. Paving asphalt complies with Section 32 12 03 requirements.

- E. Quality Control Report: Upon ENGINEER's request, submit a written quality control inspections and testing report describing source and field quality control activities performed by CONTRACTOR's Supplier and CONTRACTOR.

#### 1.4 QUALITY ASSURANCE

- A. Determine emulsion weights by mix design.
- B. Do not change source of emulsified asphalt or aggregate without supporting changes in mix design data.
- C. Reject coating products that do not meet requirements of this Section.

#### 1.5 WEATHER

- A. Temperature:
  - 1. Apply seal coat when air and roadbed temperatures in the shade are 45 deg. F. and rising.
  - 2. Do not apply seal coat if pavement or air temperature is below 55 deg. F. and falling or if the finished product will freeze before 24 hours.
- B. Moisture: Do not apply seal coat during rain, unsuitable weather, or if humidity prolongs curing.

#### 1.6 NOTICE

- A. Send written notice to residents and businesses within affected area at least 3 days before applying slurry seal.
- B. Indicate application time and when new surface can be used.
- C. Warn of potential vehicle tow away and other construction issues affecting neighborhood..
- D. Should work not occur on specified day, send a new notice.

#### 1.7 ACCEPTANCE

- A. General:
  - 1. Acceptance is by Lot. Lot is specified below.
  - 2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring material as part of its installation, Section 01 29 00.
  - 3. Dispute resolution, Section 01 35 10.
  - 4. Opening slurry seal surface to traffic does not constitute acceptance.
- B. Slurry Seal Materials:
  - 1. Paving Asphalt: Acceptance is not specified in this Section. Refer to Section 32 12 03 for acceptance.



2. Aggregate: Lot size is one day's production with 300 tons sub-lots. Collect Samples randomly from hauling equipment and test gradation, ASTM C 136. Lot will be acceptable if,
    - a. Average gradation of each sieve for the Lot is within Target Grading Band for that sieve, and
    - b. Number of Samples in Lot with any sieve measurement outside of Target Grading Band does not exceed 2, and
    - c. No Sample varies from Target Grading Band by more than target tolerance on any one sieve.
  3. Price Adjustment: Aggregate gradation defects may be accepted if 5 percent price reduction is applied against Lot for each condition not met. Maximum price reduction for a Lot is 10 percent.
- C. Placement: Accepted on a block-by-block basis.
1. Mat Appearance: Installation must survive the following visual examinations.
    - a. No free liquid drains out of mat edges.
    - b. No drag marks or streaking.
    - c. No debonding due to road contaminants.
    - d. Straight longitudinal edges with proper joints.
  2. Price Adjustment: Appearance defects may be accepted if 5 percent price reduction is applied against the Lot for each condition not met. Maximum price reduction for the Lot is 10 percent.

## PART 2 PRODUCTS

### 2.1 PAVING ASPHALT

- A. Tack Coat: Section 32 12 14.
- B. Emulsified Asphalt: ASTM D 3628 or as indicated.
  1. The residual asphalt shall constitute at least 60 percent of the emulsion by weight.
  2. The Saybolt Furol viscosity of the emulsion at 77 deg. F., ASTM D 2170 shall not exceed 50 seconds.

### 2.2 WATER

- A. Clean, non-detrimental, free from harmful chemicals.

### 2.3 AGGREGATE

- A. Material: Stone, slag, or other high quality particle or combination with the following physical properties. For heavy-duty surface applications use 100 percent crushed material.
  1. Angularity (fractured faces): Greater than 80 percent of particles by weight with at least 1 mechanically fractured faces or clean angular faces, ASTM D 5821.
  2. Hardness (toughness): less than 35 percent wear of aggregate retained on the No. 8 sieve, ASTM C 131.
  3. Weight Loss (soundness): less than 10 percent for combined coarse and fine aggregate when subjected to 5 cycles of sodium sulfate, ASTM C 88.

4. Polishing: Greater than 38, ASTM D 3319.
  5. Water Absorption: Less than 1.25 percent.
- B. Gradation: ASTM C 136. Graded by dry weight on a percent passing basis. Gradation must not vary from a high limit on one screen to a low limit on the next.
1. Target Gradation Curve must lie within one of the following Master Grading Bands. Field samples shall not vary from the Target Gradation Curve by more than the Target Tolerance.

Table 1 – Master Grading Band and Target Tolerance Limits				
US Sieve	Master Grading Band Limits			Target Tolerance Percent
	SS-I	SS-II	SS-III	
3/8 in.	–	100	100	–
No. 4	100	90 – 100	70 – 90	+/- 5
No. 8	90 – 100	65 – 90	45 – 70	+/- 5
No. 16	65 – 90	45 – 70	28 – 50	+/- 5
No. 30	40 – 65	30 – 50	19 – 34	+/- 5
No. 50	25 – 42	18 – 30	12 – 28	+/- 4
No. 100	15 – 30	10 – 21	7 – 18	+/- 3
No. 200	10 – 20	6 – 15	5 – 15	+/- 2
NOTES				
(a) Portion retained on the No. 4 sieve clean and free of clay coatings. (b) Portion passing No. 200 sieve determined by ASTM C 117 includes mineral fillers.				

## 2.4 MINERAL FILLER

- A. ASTM D 242.
- B. Portland cement, hydrated lime, limestone dust, flyash, or aluminum sulfate to regulate setting time and improve workability.
- C. Limestone dust, fly ash, and rock dust to alter aggregate gradation.

## 2.5 MIX DESIGN

- A. Proportioning: Use the consistency test of ASTM D 3910 to determine optimum ratio of aggregate, filler, water, and emulsion.
- B. Cure Time: Select to meet opening to traffic requirements.
- C. Stripping: More than 90 percent of bituminous-coated particles retain asphalt coating, ASTM D 1664.

## PART 3 EXECUTION

### 3.1 CONSTRUCTION EQUIPMENT

- A. Use equipment capable of applying at least 15,000 square yards of material per day.
- B. Use a continuous-flow mixing unit capable of accurately delivering a predetermined portion of aggregate, water, and asphalt emulsion to the mixing chamber.
- C. Prevent loss of slurry from the distributor by using a mechanical type squeegee distributor equipped with flexible material in contact with the surface.
- D. Provide a lateral control device and a flexible strike-off capable of being adjusted to lay the slurry at the mix design application rate.

### 3.2 PREPARATION

#### A. General:

- 1. Fat or bleeding Pavements may require scratch course application.
- 2. Cracked or porous pavements may require thin SSI slurry surface treatment.
- 3. Asphalt concrete inlay may be required in rut deformations.

#### B. Protection:

- 1. Protect trees, plants and other ground cover from damage.
- 2. Prune trees; Section 32 01 93. Allow equipment passage underneath. Repair tree damage at no additional cost to OWNER.
- 3. Install invert covers.
- 4. Mask Street Fixtures.
- 5. Protect curb, gutter, and sidewalk from spatter, mar or overcoat.

#### C. Traffic Control:

- 1. Control pedestrian and vehicular traffic, Section 01 55 26. Do not proceed without flaggers.
- 2. Protect slurry seal from traffic until cured. Cure time depends on type of asphalt, mixture characteristics and weather.
- 3. Do not apply lane marking tape or paint until layout and placement has been verified with ENGINEER.

#### D. Surface Repair: Patch holes, raveled areas, and low areas with asphalt concrete.

#### E. Crack Repair: Section 32 01 17.

- 1. Remove plant materials from cracks, edges and joints.
- 2. Blow cracks clean.
- 3. Seal cracks with crack pouring asphalt. Remove excess asphalt.
- 4. Allow crack seal to dry before applying slurry seal.

#### F. Cleaning:

- 1. Remove mud spots, sand, dust, oil, vegetation and other objectionable material.
- 2. Remove loose material that may cause drag marks.

3. Do not flush water over cracked Pavement.

G. Existing Roadway Striping: Use reflective tabs to mark roadway striping before applying slurry seal.

H. Tack Coat:

1. Apply tack coat to high-absorbent, polished, oxidized, or raveled asphalt surfaces or to concrete or brick surfaces.
2. Apply tack coat and pave over concrete Cover Collars.
3. Use the same asphalt emulsion as used in slurry seal application.

### 3.3 APPLICATION

A. General:

1. Application rates:
  - a. SS-I: 8 to 12 pounds per square yard.
  - b. SS-II: 12 to 16 pounds per square yard.
  - c. SS-III: 15 to 18 pounds per square yard.
2. Machine meter settings must match mix design. Water and mineral filler may be changed per mix design; otherwise, a new mix design is required.

B. In the Spreader Box:

1. Do not exceed 4-minutes total mixing time.
2. No additional water.
3. No lumping, balling or unmixed aggregate.
4. No segregation of the emulsion and aggregate fines from the coarse aggregate.
5. No breaking of emulsion.
6. No overloading. Carry a sufficient amount of slurry in all parts of the spreader for complete coverage.

C. Spreading:

1. Dampen surface immediately prior to application of slurry seal. All surfaces are to be uniformly damp with no free water standing on the surface or in cracks when seal coat is applied.
2. If coarse aggregate settles to bottom of mix, remove slurry from pavement.
3. Except for lanes in which 2 or more boxes are used in tandem in placing slurry, do not seal adjacent lanes until at least 2 hours have elapsed between placing one lane and that of adjacent lane. Lap adjacent lanes at edges to provide complete sealing at overlap.
4. When sealing short lanes, the waiting period may be omitted if the adjacent lane can be sealed before emulsion in the previously sealed lane has broken and started to cure.
5. In areas where spreader box cannot be used, apply slurry by hand.

D. Joints:

1. Correct any joints or cracks not filled by slurry seal.
2. Do not permit build-up on longitudinal or transverse joints.

Window Rock Office Building and Site  
Construction Documents

3. Smooth thick spots before emulsion breaks so a uniform surface with no breaks or discontinuities is obtained.

E. Lines

1. Mask off end of streets and intersections to provide straight lines.
2. Make straight lines along lip of gutter and shoulders. No runoff on these areas permitted.
3. Vary edge lines no more than 2 inches per 100 feet.

3.4 AFTER APPLICATION

- A. Do not permit traffic on slurry seal until cured.
- B. Leave no streaks caused by oversized aggregate, or buildup on squeegees.
- C. Leave no holes, bare spots, or cracks.
- D. The slurry, when cured shall present a uniform, skid-resistant appearance with all cracks filled.
- E. Do not apply traffic and lane marking tape or paint until layout and placement has been verified by ENGINEER.

3.5 FIELD QUALITY CONTROL

- A. ASTM C 136. If tests show aggregate gradation non-compliance, either remove the material or blend in other aggregates to bring it into compliance. This may require a new mix design. Screening may be required at the stockpile to remove any defective material.

3.6 REPAIR

- A. Remove spatter or mar from curb and gutter, sidewalk, guard rails and guide posts at no additional cost to OWNER.
- B. Remove slurry seal from Street Fixtures.
- C. Make correction lines straight. Provide good appearance.
- D. Fill any joints or cracks that are not covered by slurry seal. Leave no streaks, holes, bare spots, or cracks through which liquids or foreign matter could penetrate the underlying Pavement.
- E. Repair collateral damage caused by construction.

END OF SECTION – 32 01 13

## SECTION 32 01 17 - PAVEMENT CRACK SEAL

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Filling and sealing cracks in asphalt concrete Pavements.

#### 1.2 REFERENCES

- A. ASTM D 36: Standard Test Method for Softening Point of Bitumen (Ring-and Ball Apparatus)
- B. ASTM D 977: Standard Specification for Emulsified Asphalt.
- C. ASTM D 1190: Standard Specification for Concrete Joint Sealer, Hot- Poured Elastic Type.
- D. ASTM D 2397: Standard Specification for Cationic Emulsified Asphalt. E. ASTM D 3381: Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
- F. ASTM D 3405: Standard Specification for Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.
- G. ASTM D 5078: Standard Specification for Crack Filler for Asphalt Concrete and Portland Cement Concrete Pavements.
- H. ASTM D 5329: Standard Test Methods for Sealants and Fillers, Hot- Applied for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements.

#### 1.3 DEFINITIONS

- A. Crack Filling: The placement of materials into cracks to substantially reduce infiltration of water and to reinforce the adjacent Pavement. The crack receives no special preparation other than cleaning.
- B. Crack Sealing: The placement of specialized materials in cracks or above to prevent the intrusion of incompressibles and water into the crack. The crack receives unique crack configuration preparation.
- C. Pothole: Loss of surface material in a Pavement to the extent that a patch is necessary to restore Pavement ride quality.

#### 1.4 SUBMITTALS

- A. Product Data sheets.

#### 1.5 QUALITY ASSURANCE

- A. Do not use crack repair product that has been over-heated, suffered prolonged heating or which ravel or can be pulled out by hand after placement.

- B. Do not mix different manufacturer’s brands or different types of crack repair material.
- C. Do not depress crack repair product temperature at the wand tip below the manufacturer’s recommended application temperature when loading product into product tank.
- D. Rework Defective Work.

1.6 NOTICE

- A. Send written notice to residents and businesses within affected area at least 3 days before application of new Crack Filling or Crack Sealing material.
- B. Indicate application time and when pavement surface can be used. C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.
- D. Should work not occur on the specified day, send a new notice.

1.7 ACCEPTANCE

- A. Visually inspect areas for adhesion Failure, damage to crack repair product, missed cracks, foreign objects in the product, or other problems that indicate the Work is not acceptable.

PART 2 PRODUCTS

2.1 FILLER AND SEALER MATERIAL

- A. Crack treatment materials as follows.

Table 1 – Thermoplastic Filler and Sealer Materials		
Material Type	ASTM	Application
Hot-applied Thermoplastic Materials		
Asphalt Rubber	D 5078	Sealing (possibly filling)
Rubberized Asphalt	D 1190 D 3405	Sealing
Low Modulus Rubberized Asphalt	(a)	Sealing
Asphalt Cement	D 3381	Filling
Mineral-filled Asphalt Cement	D 3381 (b)	Filling
Fiberized Asphalt Cement	D 3381 (b)	Filling
Chemically Cured Thermosetting Materials		
Silicone	(c)	Sealing
Cold Applied Thermoplastic Materials		
Asphalt Emulsion	D 977 D 2397	Filling
Polymer-modified liquid asphalt	D 977 D 2397	Filling (possibly sealing)

NOTES

- (a) ASTM D 3405 or ASTM D 5078 except as follows.
  - Softening point, 85 deg. C. minimum, ASTM D 36.
  - Resilience, 30 percent recovery minimum at 25 deg. C plus or minus 1 deg. C, ASTM D 5329.
- (b) Additives such as mineral fillers and fibers provide minimal elasticity to asphalt and do not significantly affect temperature susceptibility.
- (c) Manufacturer's recommended specification.

B. Selection of Sealer: Hot applied asphalt rubber or hot applied rubberized asphalt, unless specified otherwise.

C. Selection of Filler: Asphalt emulsion, unless specified otherwise.

### PART 3 EXECUTION

#### 3.1 CONSTRUCTION EQUIPMENT

A. Sealant Heating Equipment: Indirect heating using double boiler or circulating hot oil heat transfer for heating the product. Do not use direct heat transfer units (tar pots). Unit must have means of constant agitation.

B. Hot Compressed Air Lance: Provide clean, oil-free compressed air at a volume of 100 cubic feet per minute at a pressure of 120 pounds per square inch at the lance tip.

#### 3.2 PREPARATION

A. Allow at least one week for repaired cracks to cure and harden before placing thin overlays.

B. Repair Potholes full depth.

#### 3.3 CRACK FILLING AND SEALING

A. Blow cracks clean. Remove foreign matter, loosened particles, and weeds.

B. Use a hot air lance when surfaces are wet or when air temperature is less than 40 deg. F. Do not burn the surrounding Pavement. Fill cracks immediately after heating with the air lance or reheat.

C. Fill each crack to within 1/4 inch of the existing surface.

D. If a thin Pavement (chip seal, slurry seal, micro-surface) is to be applied, remove crack overflow by squeegee.

#### 3.4 PROTECTION



Window Rock Office Building and Site  
Construction Documents

- A. Place sand on surface of crack repair product if traffic or construction activities are likely to cause pull out. Replace pulled out product at no additional cost to the OWNER.
- B. Repair vehicles or other property damaged by crack repair operation.

END OF SECTION 32 01 17

## SECTION 32 11 23 – AGGREGATE BASE COURSES

### PART 1 - GENERAL

#### 1.1 SUMMARY

This section covers material and construction of aggregate base under parking lots, driveways and sidewalks.

#### 1.2 OPERATION OF MATERIAL SOURCES

Clearing, stripping, and excavating involved in the operation of pits or quarries shall be performed by the Contractor. Pits or quarries on private lands shall be conditioned in agreement with local laws or authorities.

### PART 2 - PRODUCTS

#### 2.1 BASE COURSE MATERIALS

A. Aggregates shall consist of clean, sound, durable particles of crushed stone, or crushed gravel, and screenings. The Contractor shall be responsible for obtaining and testing materials that meet the requirements specified and that can be used to meet the grade and smoothness requirements specified after all compaction and proof rolling operations have been completed. Aggregates shall be free of silt, clay, vegetable matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate, that passing the No. 4 sieve shall be known as fine aggregate.

#### B. COURSE AGGREGATE

Course aggregate shall be angular particles of uniform density. Coarse aggregate shall have a loss not greater than 12 percent weighted average at five cycles when tested for soundness in magnesium sulfate in accordance with ASTM C88. Coarse aggregate shall have a percentage of wear not to exceed 45 after 500 revolutions as determined by ASTM D131. When coarse aggregate is supplied from more than one source, aggregate from each source shall meet the requirements set forth. Crushed gravel shall conform to the requirements specified, and the Contractor shall notify in writing to which of the following requirements the crushed gravel shall conform.

In the portion retained on each sieve specified, the crushed gravel shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces.

C. FINE AGGREGATE

Fine aggregate shall be angular particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for coarse aggregate. Fine aggregate derived from gravel shall conform to the requirements specified.

Fine aggregate derived from gravel shall be produced by crushing particles larger than 0.187 inch (No. 4 sieve) in size. Fine aggregate shall contain at least 90 percent by weight of particles having two or more freshly fractured faces in the portion passing the No. 4 sieve and retained on the No. 10 sieve, and in the portion passing the No. 10 sieve and retained on the No. 40 sieve.

Fine aggregate derived from gravel shall be manufactured from gravel particles 95% of which by weight are retained on the 1/2-inch sieve.

D. GRADATION

Gradation requirements specified shall apply to the completed base course after undergoing the mixing, placing, compacting, and other operations. Aggregates shall have a maximum size of 1-1/2 inches and be graded continuously within the limits specified below. Sieves shall conform to ASTM E11.

GRADATION OF AGGREGATES  
PERCENTAGE BY WEIGHT PASSING  
SQUARE-MESH SIEVE

<u>SIEVE DESIGNATION</u>	<u>PASSING</u>
2-inch	100
1-1/2-inch	95 - 100
3/4-inch	70 - 98
3/8-inch	50 - 70
No. 4	35 - 55
No. 30	12 - 25
No. 200	0 - 8

E. Liquid limit and plasticity index

Liquid limit and plasticity index requirements as stated shall apply to the aggregate component that is blended to meet the required gradation and also to the aggregate in the completed base course. The portion of the aggregate passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 6.

## PART 3 - EXECUTION

### 3.1 PREPARATION OF SUBGRADE OR SUBBASE COURSE

- A. Prior to constructing the crushed-aggregate base course, the previously constructed subgrade or subbase course shall be cleaned of foreign substances. At the time of construction of the base course, the subgrade or subbase course shall contain no frozen material.
- B. Subgrade shall conform to the requirements of Division 31, Section "Earthwork"
- C. During construction, lines and grades, including crown and cross slope indicated for the base course, shall be maintained by means of line and grade stakes placed by the Contractor at the work site.
- D. If required to obtain proper gradation, coarse and fine aggregates shall be mixed in an approved stationary plant.

#### E. STATIONARY PLANT METHOD

Course and fine aggregate shall be proportioned by weight or by volume in such quantities that specified gradation and liquid-limit and plasticity-index requirements shall be met after base course has been placed and compacted. Adjustments in percentages of coarse and fine aggregates shall be made as directed. Water measured by weight or volume in approved quantities shall be incorporated during the mixing operation. Mixing operations shall produce satisfactory uniform blending. Discharge into trucks shall not produce segregation.

#### F. PLACEMENT OF BASE COURSE

Material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. Layers shall not exceed 6 inches or be less than 3 inches when compacted. Layers shall be placed so that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is constructed in more than one layer, previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweeps, power brooms, or hand brooms, as directed. Water content of the material shall be maintained during the placing period at the percentage specified. Adjustments in placing procedures or equipment shall be made as directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory base course.

#### G. COMPACTION

Each layer of base course shall be compacted with approved equipment until the layer is compacted through the full depth to at least 95 percent maximum density as determined by ASTM D1557 at a moisture content between -2 and +2 percent of optimum.

The surface of top layer of base course shall be finished after final compaction and proof rolled where required by cutting any overbuild to grade and rolling with a steel-wheeled

roller. In no case shall thin layers of material be added to the top layer of base course in order to meet grade. If the elevation of top layer of base course is 1/2 inch or more below grade, the top layer of base shall be excavated and replaced with new material to a depth of at least 3 inches in compacted thickness. New material shall then be compacted as specified. Adjustments in rolling and finishing procedures shall be made as directed to obtain true grades, to minimize segregation and degradation of base-course material, to reduce or increase water content, and to ensure a satisfactory base course. Material found unsatisfactory shall be removed and replaced, as directed, with satisfactory material.

#### H. SMOOTHNESSTEST

The surface of the top layer of the finished and completed base course shall indicate deviations not exceeding 3/8 inch when tested with a 10-foot straightedge applied parallel with, and at right angles to, the centerline of the paved area and shall vary not more than 1/2 inch from the elevations indicated. Deviations exceeding 3/8 inch and variations more than 1/2 inch shall be corrected as directed.

### 3.2 THICKNESS CONTROL

Completed thickness of the base course shall be within 1/2 inch of the thickness indicated. Thickness of the base course shall be measured at intervals providing one depth measurement for at least each 500 square yards of base course. Depth measurement shall be made by test holes at least 3 inches in diameter. Where the measured thickness of the base course is more than 1/2 inch deficient, such areas shall be corrected by excavating to the required depth and replacing with new material. Where the measured thickness of the base course is 1/2 inch more than indicated, it will be considered as conforming with the requirements plus 1/2 inch, provided the surface of the base course is within 1/2 inch of established grade. Average job thickness shall be the average of job measurements as specified above but within 1/4 inch of thickness indicated.

### 3.3 MAINTENANCE

The base course shall be maintained in a condition that will meet all specification requirements until accepted and paved over. Base course material which is left open and exposed to the weather for an extended period of time shall be proof-rolled, recompact and retested prior to placement of pavement. Any area found to be soft and pumping after initial acceptance will be removed to the full base course depth and replaced with new base course material at no additional cost to the owner. Additionally, any areas of base course left exposed to the weather and contaminated by sediment, silts or other soils shall be removed to the full base course depth and replaced with new base course material at no additional cost to the owner.

END OF SECTION 32 11 23

## SECTION 32 12 03 - PAVING ASPHALTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Performance graded asphalt, asphalt cement, cutback asphalt, emulsified asphalt, recycle asphalt, and crack patch asphalt.
- B. Requirements for accepting non-complying paving asphalts.

#### 1.2 REFERENCES

- A. ASTM D 113: Standard Test Method for Ductility of Bituminous Materials.
- B. ASTM D 977: Standard Specification for Emulsified Asphalt.
- C. ASTM D 2026: Standard Specification for Cutback Asphalt (Slow- Curing Type).
- D. ASTM D 2027: Standard Specification for Cutback Asphalt (Medium- Curing Type).
- E. ASTM D 2028: Standard Specification for Cutback Asphalt (Rapid- Curing type).
- F. ASTM D 2397: Standard Specification for Cationic Emulsified Asphalt. G. ASTM D 3381: Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
- H. ASTM D 4552: Standard Practice for Classifying Hot-Mix Recycling Agents.
- I. ASTM D 5710: Standard Specification for Trinidad Lake Modified Asphalt.
- J. ASTM D 6373: Standard Specification for Performance Graded Asphalt Binder.

#### 1.3 SUBMITTALS

- A. Submit bill of lading for each shipment of paving asphalt from vendor. Identify the following.
  - 1. Source of product (manufacturer);
  - 2. Type and grade of asphalt, And
  - 3. Type and amount of additives in the product.

#### 1.4 QUALITY ASSURANCE

- A. Reject paving asphalts which are not uniform in appearance and consistency or which foam when heated to mixing temperature.
- B. Do not use storage containers contaminated with other types or grades of Petroleum products.

- C. Do not use Petroleum product that does not comply with contract requirements.

## 1.5 ACCEPTANCE

### A. General:

1. Acceptance is by Lot. One Lot is one day's production.
2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring material as part of its installation. Section 01 29 00
3. Dispute resolution, Section 01 35 10.

### B. Performance Graded Asphalt Binder (PGAB): Sub-lot size is 20,000 gallons. Collect sub-lot Sample randomly from oil storage unit.

1. Refer to limits identified in Section 209 of UDOT's "Manual of Instruction Part 8 Materials". Pay factors are as follows.
  - a. If none of the critical properties are outside rejection limit a composite price adjustment of 25 percent or less is allowed.
  - b. If one or more of the critical properties falls outside the rejection limit or if a composite price adjustment is more than 25 percent, paving asphalt will be rejected.

### C. Asphalt Cement (AC) Binder: Sub-lot size is 20,000 gallons. Collect sub-lot Sample randomly from oil storage unit.

1. Ductility: Meet this Section's requirements, or
2. Viscosity or Penetration: Meet graphics published in Section 955 of UDOT's "Manual of Instructions, Part 8 Materials".
  - a. Lot may be accepted using the published graphics. If price adjustment exceeds 30 percent, reject paving asphalt, or
  - b. If allowed to remain after placement, price adjustment will be 50 percent.

### D. Cut-back Binder: Meet this Section's requirements for ductility.

### E. Trinidad Lake Modified Asphalt: Supplier's certificate for ASTM compliance.

### F. Emulsified Asphalt: Supplier's certificate for ASTM compliance.

### G. Recycle Asphalt: Identity of source (asphalt cement or tar products).

### H. Crack Patch: Meet material requirements in Section 32 01 17.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE GRADE ASPHALT BINDER (PGAB)

- A. Petroleum asphalt that complies with ASTM D 6373. Blending the paving asphalt with

polymers or natural asphalts is CONTRACTOR's choice.

## 2.2 ASPHALT CEMENT (AC)

- A. Petroleum asphalt that complies with Table 2 of ASTM D 3381 except as follows:
1. Replace ductility at 77 deg. F. (25 deg. C.) with ductility at 39.2 deg. F. (4 deg. C.). Use the following values.
    - AC-5: greater than 25.
    - AC-10: greater than 15.
    - AC-20: greater than 5.
  2. Delete the loss on heating requirement on residue from "Thin-Film Oven Test".
- B. AC-5 Latex Additive: Anionic emulsion of butadiene-styrene low- temperature copolymer consisting of 2 percent by weight (solids basis), stabilized with fatty-acid soap for storage stability.

## 2.3 TRINIDAD LAKE MODIFIED ASPHALT (TLA)

- A. Petroleum asphalt that complies with ASTM D 5710 (a blend of natural asphalts).

## 2.4 SLOW CURE CUT-BACK ASPHALT (SC)

- A. Petroleum asphalt that complies with ASTM D 2026 (fluxed with a light oil) except if penetration of residue is more than 200 and its ductility at 77 deg. F (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg. F. (15 deg. C) is greater than 100.

## 2.5 MEDIUM CURE CUT-BACK ASPHALT (MC)

- A. Petroleum asphalt that complies with ASTM D 2027 (fluxed or blended with a kerosene-type solvent, non-foaming when heated to application temperature) except if penetration of residue is more than 200 and its ductility at 77 deg. F. (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg. F. (15 deg. C) is greater than 100.

## 2.6 RAPID CURE CUT-BACK ASPHALT (RC)

- A. Petroleum that complies with ASTM D 2028 asphalt (fluxed or blended with a naphtha-solvent, non-foaming when heated to application temperature).

## 2.7 EMULSIFIED ASPHALT

- A. Petroleum asphalt uniformly emulsified with water, homogeneous throughout, and when stored, shows no separation within 30 days after delivery. Frozen emulsions not accepted.
1. Anionic, ASTM D 977 (breaks by evaporation).
  2. Cationic, ASTM D 2397 (breaks chemically).

## 2.8 RECYCLE ASPHALT (RA)



Window Rock Office Building and Site  
Construction Documents

- A. Petroleum asphalt that complies with ASTM D 4552 (homogeneous, free-flowing at pumping temperature made from maltene fractions of asphalt cement for surface revitalization or from tar products to make Pavements resistant to fuel spillage.
  - 1. RA-1, RA-5, RA-25 or RA-75 for recycling RAP when less than 30 percent virgin aggregate is added.
  - 2. RA-250 or RA-500 when more than 30 percent virgin aggregate is added to the RAP.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Prime coat, Section 32 12 13.
- B. Tack coat, Section 32 12 14.
- C. Plant mix paving, Section 32 12 17.
- E. Seal coating, Section 32 01 13.
- F. Crack patch, Section 32 01 17.

END OF SECTION 32 12 03

## SECTION 32 12 13

### PART 1

#### 1.1 SECTION INCLUDES

- A. Application of liquid asphalt to aggregate base prior to placing asphalt concrete or portland cement concrete Pavement.
- B. Placing sand on areas that are over-primed.

#### 1.2 SUBMITTALS

- A. Certificate showing asphaltic material complies with Section 32 12 03.

#### 1.3 WEATHER

- A. Apply prime coat only when air and roadbed temperatures in the shade are greater than 40 deg. F. The temperature restrictions may be waived only upon written authorization from ENGINEER.
- B. Do not apply prime coat during rain, fog, dust, or other unsuitable weather.

### PART 2 PRODUCTS

#### 2.1 ASPHALT MATERIAL

- A. Select from the following:
  - 1. Slow Cure Cutback Asphalt: Grade SC-70, or SC-250, Section 3212 03.
  - 2. Medium Cure Cutback Asphalt: Grade MC-30, MC-70, or MC-250, Section 32 12 03.
  - 3. Rapid Cure Cutback Asphalt: Grade RC-1, RC-2, or RC-250, Section 32 12 03.

#### 2.2 SAND

- A. Clean natural aggregate passing the No. 4 sieve and retained on the No. 200 Sieve.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. If aggregate base course to be primed contains an appreciable amount of loose material or is excessively dusty; moisten, blade, roll, and recompact to make the surface dense.
- B. Do not start priming until all free surface moisture has disappeared.

- C. Notify residents and business owners 24 hours prior to applying prime coat.
- D. Provide pedestrian access across prime coat if required.

### 3.2 APPLICATION

- A. When Pavement surface under Pavement overlay is loosely bonded, apply prime coat at 0.10 to 0.50 gallons per square yard to penetrate and seal. Do not flood surface.
- B. Cure and dry as long as necessary to attain penetration and evaporation of volatile.
- C. Blot over-primed surface by spreading a light, uniform layer of sand. D. Prime under-primed areas with additional asphalt.

### 3.3 PROTECTION

- A. Protect all structures, including curb and gutter, sidewalks, guardrails and guide posts from being splattered or marred. Remove any splattering, over-coating, or marring at no additional cost to OWNER.
- B. Do not discharge bituminous material into borrow pits or gutters.
- C. Prevent tracking of prime coat onto adjacent surfaces.

### 3.4 OPENING TO TRAFFIC AND MAINTENANCE

- A. Do not permit traffic to travel over freshly primed surface until prime coat has cured. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the paving area.
- B. After prime coat application, leave work area undisturbed. If prime coat is tacky or tends to pick up under traffic after 4 hours, blot excess prime coat with blotter sand. Prime coats can be opened to traffic after blotting.
- C. Clean and maintain primed surfaces until surface Pavement course is placed. Maintenance includes spreading any necessary additional blotter material, replacing all portions of prime coat that have been destroyed, and patching any break in primed surfaces.

END OF SECTION 32 12 13

## SECTION 32 12 14 – TACK COAT

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Application of asphaltic material to existing asphalt concrete or portland cement concrete surfaces preparatory to placing an asphalt concrete Pavement.

#### 1.2 SUBMITTALS

- A. Certificate showing asphaltic material complies with Section 32 12 03.
  - 1. Identify water/asphalt dilution ratio.
  - 2. Identify tack coat application rate.
- B. Identify asphalt material recommended by fabric manufacturer.

#### 1.3 WEATHER

- A. Apply tack coat only when air and roadbed temperatures in the shade are greater than 40 deg. F. The temperature restrictions may be waived only upon written authorization from ENGINEER.
- B. Do not apply tack coat during rain, fog, dust, or other unsuitable weather. Do not apply coat to wet surfaces.

#### 1.4 NOTICE

- A. Send written notice to residents or business owners 24 hours prior to applying coat.

### PART 2 PRODUCTS

#### 2.1 ASPHALT MATERIAL

- A. Select from the following.
  - 1. Emulsified Asphalt: Grade MS-1, SS-1 or SS-1h, Section 32 12 03.
  - 2. Cationic Emulsified Asphalt: Grade CSS-1 or CSS-1h, Section 32 12 03.
  - 3. Rapid Cure Cutback Asphalt: Grade RC-70, Section 32 12 03.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Select and advise ENGINEER of the type of tack material to be used.

- B. Clean the surface to be treated free of dust and other foreign material. If flushed, allow surface to dry. If leaves from trees, blow clean.
- C. Provide surface for pedestrian access across tack coat.
- D. Prevent pedestrians, vehicles, pets, etc., access to tack surfaces.

### 3.2 APPLICATION

- A. General:
  - 1. Triple coverage by spray bar required. Stop application if any nozzle is not working properly.
  - 2. Apply tack only to area covered with asphalt concrete in the same day.
- B. Application rate: Typically as follows.
  - 1. Emulsions, 0.05 to 0.15 gallons per square yard.
  - 2. Cutback, CONTRACTOR's choice.
- C. Tack Substrate for Fabric Application: Comply with manufacturer's recommendation. If none, then as follows.
  - 1. Dry Pavement surface, 0.20 to 0.30 gallons per square yard. Within street intersections, on steep grades and in zones where vehicle speed changes are commonplace reduce the application rate to no less than 0.20 gallons per square yard.
  - 2. Heavy duty fabrics, 0.30 to 0.40 gallons per square yard.

### 3.3 PROTECTION

- A. Protect all surfaces exposed to public view from being spattered or marred. Remove any spattering, over-coating, or marring.
- B. Do not discharge bituminous material into borrow pits or gutters.

### 3.4 OPENING TO TRAFFIC AND MAINTENANCE

- A. Do not permit traffic to travel over the tacked surface until bituminous tack coat has cured or is not picked up by traffic.
- B. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the road.
- C. If one-way traffic is provided, control traffic appropriately.

END OF SECTION 32 12 14

## **SECTION 32 12 16 – ASPHALT PAVING**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Place plant-mix asphalt concrete in base, leveling and surface courses, or overlay.

#### **1.2 REFERENCES**

- A. AASHTO T 324: Hamburg Wheel-track Testing of Compacted Hot- Mix Asphalt (HMA).
- B. ASTM D 979: Standard Practice for Sampling Bituminous Paving Mixtures.
- C. ASTM D 2041: Standard Test Method for Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.
- D. ASTM D 3549: Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
- E. ASTM D 3665: Standard Practice for Random Sampling of Construction Materials.
- F. ASTM E 950: Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.
- G. ASTM E 1274: Standard Test Method for Measuring Pavement Roughness Using a Profilograph.

#### **1.3 SUBMITTALS**

- A. Before Delivery:
  - 1. Traffic control plan, Section 01 55 26.
  - 2. Type and number of rollers.
  - 3. Location and name of asphalt concrete production facility.
  - 4. Proof of profilograph and profilograph operator certification.
  - 5. Mix Design: Submit proposed mix design for each asphaltic concrete mixture and seal coat to be used in the work, covering the specific materials to be used in the mixes. Include test data in support of each proposed mix design.
  
- B. At Delivery: Supply batch ticket identifying.
  - 1. Serial number of ticket.
  - 2. Date and truck number.
  - 3. Job name, location, and mix identification.
  - 4. Type, grade, and weight of asphalt.
  - 5. Type, grade, and weight of aggregate.
  - 6. Mix design method.
  
- C. After Delivery:
  - 1. Profile deviation report.
  - 2. Profile roughness index report.
  - 3. Test Reports: Submit test results of sampling and testing, and inspection records within 24 hours of asphaltic concrete placement.

#### **1.4 QUALITY ASSURANCE**

Window Rock Office Building and Site  
Construction Documents

- A. Do not change asphalt or aggregate sources until ENGINEER accepts new source and new mix design.
- B. Reject product and work that does not meet requirements of this Section. C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.
- C. Foreman of paving crew has completed at least three (3) projects of similar size and nature.

### 1.5 WEATHER

- A. Do not pave until air temperature is 45 deg F. and rising.
- B. Cease paving if air temperature falls below 50 deg F.
- C. Do not pave if surface is wet or weather is unsuitable.
- D. Do not pave if wind or ground cools mix material before compaction.

### 1.6 NOTICE

- A. Send written notice to residents and businesses within affected area at least 3 days before start of paving.
- B. Indicate paving time and when new surface can be used.
- C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.
- D. Should work not occur on specified day, send a new notice.

### 1.7 ACCEPTANCE

- A. General:
  - 1. Acceptance is by Lot. Lot size is specified below.
  - 2. If non-complying material has been installed and no price for the material is specified, apply price adjustment against cost of work requiring material as part of its installation. Section 01 29 00.
  - 3. Dispute resolution, Section 01 35 10.
  - 4. Opening a paved surface to traffic does not constitute acceptance.
- B. Mix: Accepted as specified in Section 32 12 05.
- C. Installation:
  - 1. Mix Temperature:
    - a. Reject mixes exceeding 325 deg F. in transport vehicle.
    - b. Dispose of cold mix in paver hopper as thin spread underlay.

2. Compaction and Thickness:
  - a. Lot size is 1,000 square yards or part thereof.
  - b. Verify with at least 2 tests per Lot.
  - c. Select test locations by ASTM D 3665 and sample per ASTM D 979 after compaction.
  - d. Compaction determinations are full core depth or overlay depth in overlay construction.
  - e. Thickness measurement will not apply in overlay construction.
  - f. Based upon core samples, compaction and thickness is acceptable if test deviations are within pay factor 1.00 limits. At ENGINEER’s discretion, a Lot with a sub-lot test deviation greater than Reject may stay in place at 50 percent cost.

Table 1 – Compaction Pay Factors		
Pay Factor	Density, in Percent	
	Average	Lowest Test
0.70	More than 96	–
1.00	92 to	89 or greater
0.90	92 to	Less than 89
Reject	Less than 92	–

NOTES  
(a) At CONTRACTOR’s discretion and expense, do Hamburg wheel track test (AASHTO T 324) on 3 additional random core samples from a non-complying sub-lot. The sub-lot will be accepted if average rut depth is less than 10 mm at 20,000 passes.

Table 2 – Thickness Pay Factor	
Pay Factors	Thickness Deficiency, in Inches
1.00	0.00 to
0.90	0.26 to
0.70	0.51 to
Reject	0.76 to

3. Grade, Cross Slope: Verify tolerance is not exceeded.
4. Roughness: Verify “must grind” bumps are removed and tolerance for profile roughness index is not exceeded.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Asphalt concrete, Section 32 12 05.
- B. Prime coat, Section 32 12 13.



- C. Tack coat, Section 32 12 14.

### **PART 3 EXECUTION**

#### **3.1 CONSTRUCTION EQUIPMENT**

- A. Lay Down Machine: Use track equipment when operating on Pavement mats hotter than 180 deg. F.
- B. Compactors: Steel wheel static or vibratory. Use pneumatic tire roller for intermediate rolling only.

#### **3.2 PREPARATION**

A. General:

1. Coordinate utility location, Section 01 31 13. Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
2. Lower Street Fixtures if paving machine is not capable of passing over the fixtures.
3. Remove vegetation from cracks, edges and joints. Sweep surface clean. Blow cracks clean. Remove leaves.
4. Fill cracks and fix Potholes.
5. Stabilize concrete Subgrade slabs.

B. Trees, Plants, Ground Cover:

1. Protect trees, plants and other ground cover from damage.
2. Prune trees to allow equipment passage underneath. Repair tree damage at no additional cost to OWNER.

C. Traffic Control:

1. Provide worker and public safety, Section 01 55 26.
2. Apply temporary traffic and lane marking tape or paint after layout has been verified with ENGINEER.

D. Aggregate Base Course:

1. Base course shall be minimum uniform thickness after compaction of dimensions indicated. Where not indicated, compacted thickness shall be 6 inches for parking stalls and 8 inches for roads, driveways, and aisles of parking areas.
2. Base course shall be placed over finished sub grade and compacted in accordance with Section 32 11 23 - Aggregate Base Courses.
3. Verify base course is placed to grade and compacted.
4. If indicated, follow Section 32 12 13 for prime coat.

- E. Tack Coat: Apply tack coat, Section 32 12 14 if inlay or subbase Pavement surface is dirty or older than 24 hours.

#### **3.3 TEMPORARY SURFACING**

- A. Place, roll, maintain, remove and dispose of temporary surfaces.

- B. In sidewalk areas construct temporary Pavements at least 1 inch thick and in all other areas at least 2 inches thick. At major intersections and other critical locations a greater thickness may be required.

### 3.4 PLACE PAVEMENT MIXTURE

- A. General: Areas to be paved shall be covered with a layer of hot asphalt concrete surfacing not less than the thickness indicated after compaction. Where not indicated, compacted thickness shall be 3 inches for parking stalls and 4 inches for roads, driveways, and aisles of parking areas.

1. Provide continuous forward movement such that minimum temperature 10 feet behind paver is as follows.

Table 3 – Minimum Temperature, Degrees F.						
Air Temperature Deg F.	Compacted Mat Thickness					
	3/4"	1"	1-1/2"	2"	3"	4"+
45 - 50	-	-	-	-	280	265
50 - 59	-	-	-	280	270	255
60 - 69	-	-	285	275	265	250
70 - 79	285	285	280	270	265	250
80 - 89	280	275	270	265	260	250
90 +	275	270	265	260	250	250

2. Do not leave unsafe butt joints if paving operation stops.  
3. Barricade or eliminate fall off edges. B. Overlays or

Subsequent Lifts:

1. Allow new base Pavement or new inlay Pavement to harden (cure) prior to placing overlays.  
2. Apply tack coat per Section 32 12 14 if inlay or sub-base pavement surface is dirty or older than 24 hours.

- C. Irregular Areas: Handwork is acceptable if specified grades, slopes, compaction and smoothness is achieved.

D. Compaction:

1. Do not over compact or under compact.  
2. Complete compaction before temperature drops to 180 deg. F.

E. Joints:

1. Construct joints to have same texture, density and smoothness as other sections of new Pavement course.  
2. Clean contact surfaces and apply tack coat. Ensure continuous bond between old and new Pavements, or between successive day's work.  
3. Offset longitudinal joints a minimum of 12 inches in succeeding courses and at least 6 feet transversely to avoid a vertical joint through more than one course. In the top course restrict longitudinal joint to 1 foot either side of lane lines.  
4. Prevent traffic, including construction traffic, from crossing vertical edges. Apply tack coat to vertical edges prior to making another pass with the paver if the mix has cooled to 90 deg. F.

### 3.6 TOLERANCES

- A. Compaction: 95 percent plus of theoretical maximum specific gravity, ASTM D 2041 (Rice Method).
- B. Lift Thickness:
1. Not less than 2 times the maximum aggregate size in compacted asphalt concrete mixes.
  2. Not less than 4 times the nominal maximum aggregate size in compacted SUPERPAVE mixes.
  3. Not more than limits established by pneumatic or vibratory compactor equipment manufacturer.
- C. Grade: After completion of paving work, all paving shall be flooded with water, and any resulting "ponds" shall be ringed with chalk. Such hollows shall be corrected with addition of asphalt paving materials and re-rolling until all paving is completely level and free from hollows and high spots.
- D. Cross Slope: 1/4 inch in 10 feet perpendicular to centerline except at cross section grade breaks.
- E. Roughness:

Table 4 – Roughness Tolerance						
Speed and Traffic Class		Profile Roughness Index, (PRI) Inches / Mile				Profile Deviation Inches/25 feet Maximum
		IRI		PI		
		Min	Max	Min	Max	
0 to 29 mph	I or II	–	–	–	–	0.4
	III or IV	129	177	46	66	0.4
30 to 44 mph	I or II	90	115	35	50	0.4
	III or IV	70	90	21	35	0.4
45 mph +	All	–	70	–	21	0.3

NOTES

- (a) Use a zero blanking band.
- (b) As a minimum, trace right wheel path in direction of travel
- (c) Traffic class is defined in Table 3 of Section 32 12 05.
- (d) IRI (International Roughness Index), ASTM E 950
- (e) PI (Profile Index), ASTM E 1274.

1. Profile Deviation: Begin traces 50 feet before edge of new pavement and end traces 50 feet after edge of new pavement. Areas exceeding profile deviation tolerance are "must grind" areas.
2. Profile Roughness Index: (PRI)
  - a. Lot is 0.1 lane mile (528 feet long one lane wide). Add segments shorter than 250 feet to preceding Lot. Treat partial segments longer than 250 feet as a Lot.
  - b. Exclude from the Lot are turn lanes, parking lanes, medians,  
  
Street Fixtures, crowns of intersecting streets, bridge decks, grades greater than 8 percent, and vertical curves less than 1,000 feet radius (including super-elevation transitions).

### 3.7 PROTECTION AND REPAIR

A. General: All expenses are at no cost to OWNER.

B. Protection.

1. Protect all structures, including curb, gutter, sidewalks, guard rails and guide posts.
2. Remove spatter, over-coat, or mar.
3. Do not discharge bituminous materials into borrow pits or gutters.
4. Protect hot pavement from traffic until mixture has cooled enough not to become marked.
5. Protect neighborhood, storm drains and down-stream fish habitat.

C. Repair.

1. Corrective Action for Profile Deviations (“Must Grinds”): Grinding is acceptable.
2. Corrective Action for Profile Roughness Index: Grinding is acceptable. Skin patch for depressions is not acceptable. Raise depressions by milling and inlay. Re-profile corrected segments to verify index meets tolerance.
3. When thickness is deficient, place additional material over deficient areas. DO NOT skin patch. Mill for inlay if necessary.
4. Defective Joints, Seams, Edges: Repair.
5. Unacceptable Paving: Remove and replace.

END OF SECTION 32 12 16

## SECTION 32 13 13 - CONCRETE PAVING

### PART 1 - GENERAL

#### 1.0 SUMMARY

- A. This section consists provisions for Cast In Place Concrete (Sitework Only) for the placement of exterior concrete curbs, gutters and walkways. Provide all labor, materials and equipment necessary for placement of concrete slabs, sidewalks, and walkways as shown on the Drawings and specified herein.

#### 1.1 REFERENCES

- A. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- B. ACI 305 and 306 - Hot and Cold Weather Protection for Concrete.
- C. ACI 309 - Recommended Practice for Consolidation of Concrete.
- D. ACI 315 - Details and Detailing of Concrete Reinforcement.
- E. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
- F. ASTM C33 - Concrete Aggregates.
- G. ASTM C94 - Ready-Mixed Concrete.
- H. ASTM C150 - Portland Cement.
- I. ASTM C260 - Air Entraining Admixtures for Concrete.
- J. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- K. ASTM C494 - Water Reducing Admixtures for Concrete.
- L. ASTM C618 - Fly Ash Mineral Admixture for Concrete.
- M. ASTM C672 - Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.
- N. CRSI - Manual of Standard Practice.

#### 1.2 SUBMITTALS

- A. The site is subject to wide temperature swings both daily and seasonal. Contractor shall submit concrete jointing plan and related joint material details to the Contracting Officer for approval.

#### 1.3 QUALITY CONTROL

- A. Requirements of Regulatory Agencies: Comply with all applicable provisions of the state and local building and safety codes.
- B. Reference Standards: Comply with the referenced standards except where more stringent requirements are shown or specified.
- C. Design Criteria:

1. Formwork Design: The Contractor shall assume all responsibility for the safety of the formwork and shall provide all necessary design, construction, materials, and maintenance to produce the required concrete work safely.
- D. The Contractor is responsible for quality control, including workmanship and materials furnished by any entity.
1. Inspection or testing does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents.
  2. Workmanship: The Contractor is responsible for and shall bear the cost of correcting concrete work which does not conform to the specified requirements including, but not limited to, damage due to thermal transients, strength, tolerances, joint types and patterns, and finishes. Correct deficient concrete by means acceptable to the Contracting Officer. The cost of extra work incurred to approve corrective work shall be borne by the Contractor.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency: A Testing Agency acceptable to the Owner shall provide testing services at the Contractor's expense.
- B. Source Quality Control: Testing Laboratory shall be offered uninterrupted access to the ready-mix batching plant at all time that the work is in progress.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Materials handling and batching shall conform to applicable provisions of ASTM C94.
- B. Reinforcing: Unload and store reinforcing bars so they will be kept free of mud and damage.
- C. Concrete:
1. Hauling Time: Discharge all concrete transmitted in a truck mixer, agitator, or other transportation device not later than 1-1/2 hours, or 300 revolutions of the drum after the mixing water has been added, whichever is earliest.
- D. Extra Water:
1. Deliver concrete to site in exact quantities required by design mix.
  2. Should extra water be required for workability before depositing concrete and water/cement ratio of accepted mix design has not been exceeded, Contractor's superintendent shall have sole authority to authorize addition of water. Any additional water added to mix after leaving batch plant shall be indicated on truck ticket and signed by person responsible.
  3. Where extra water is added to concrete it shall be mixed thoroughly for 50 revolutions of drum before depositing.
  4. Water may be added to the concrete only once for each batch.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Requirements:
1. Cold Weather Placement:

- a. Comply with the requirements of ACI Specification 306R.
  - b. Subject to acceptance of Contracting Officer an accelerating admixture may be used. Admixtures shall meet applicable requirements. Calcium Chloride and other chloride-type accelerating admixtures will not be allowed.
2. Hot Weather Placement:
- a. Comply with the requirements of ACI 305.
  - b. Retarding admixture may be used subject to acceptance of Contracting Officer. Admixtures shall meet applicable requirements.
  - c. Protect to prevent rapid drying. Start finishing and curing as soon as possible.
- B. Protection: Protect newly finished slabs from rain damage, animal tracking and vandalism.

## PART 2 - PRODUCTS

### 2.0 MATERIALS

- A. Forms: Either steel or wood, of size and strength to resist movement during concrete placement and retain horizontal and vertical alignment until removal. Use forms that are straight and free of distortion and defects. Do not use bent, twisted, split or defective form materials.
1. Use flexible spring steel forms or laminated boards to form radius bends as required.
  2. Coat forms with non-staining, clear, paraffin base oil that will not discolor or otherwise deface the surface of the concrete.
- B. Fillets for Chamfered Corners: Wood strips or rigid plastic type; size as detailed; maximum possible lengths.
- C. Form Ties: Snap-off metal, of required length, 1-inch diameter cone ends at exposed concrete.

### 2.1 CONCRETE MATERIALS

- A. Provide concrete with a minimum 28-day compressive strength of 3000 psi shall be required unless otherwise noted in the plans and specifications.
- B. Calcium Chloride: Use is prohibited.
- C. Use of admixtures will not relax cold weather placement requirements.
- D. Bituminous Control Joint Filler: Preformed nonextruding bituminous treated fiberboard as manufactured by W. R. Meadows, Inc. (Sealtight) or equivalent, substitute.
- E. Membrane curing compounds: Surface-membrane type as manufactured by Chem Masters Corp. (Kurex), W. R. Grace Company (Horn Clear Seal), Lambert Corporation (Concrete Curing Compound), Master Builders (Floor Coat), Toch Brothers Corp. (Curetox) or equivalent substitute.
- F. Reinforcing: Fibermesh® or equal at a rate of 1.25 pounds per cubic yard in all slabs unless otherwise noted.

### 2.2 ACCESSORIES

Window Rock Office Building and Site  
Construction Documents

- A. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, contain oils or waxes, or impair natural bonding or color characteristics of coating intended for use on concrete.
  - 1. Pro-Cote manufactured by Protex
  - 2. Cast Off manufactured by Sonneborn or
  - 3. Debond manufactured by L&M Construction Chemicals
- B. Anti-Spalling Compound: ASTM C309; 50 percent (by volume) boiled linseed oil and 50 percent (by volume) mineral spirits; Promulsion 60 manufactured by Protex or ASTM C672; 35 percent solids epoxy polyester sealer; Super Seal #35 manufactured by L&M Construction Chemicals.
- C. Non-shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 10,000 psi in 28 days; Masterflow 713 manufactured by Master Builders, Five Star Grout manufactured by U.S. Grout Corp., Propak manufactured by Protex or Crystex manufactured by L&M.
- D. Expansion Joints:
  - 1. Exterior Use Where Sealants Are Specified: Bituminous saturated fiber conforming to ASTM D1751, 2 inch thickness. Provide manufacturer's certification of compatibility with specified sealants where required.
  - 2. Exterior Use Where Sealants Are Not Specified: Premolded asphalt and fiber conforming to ASTM D994, 2 inch thickness.

### 2.3 CURING MATERIALS

- A. Water: Clean and not detrimental to concrete.
- B. Curing and Sealing Compound - Compounds complying with ASTM C 309. Apply per manufacturer's recommendations.

### 2.4 JOINT SEALANT MATERIALS

- A. Product: Subject to compliance with requirements, provide one of the following:
  - 1. "Cold-Applied SOF-SEAL," W.R. Meadows, Inc., or equal.
- B. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- C. Two-Part, Low-Modulus Sealant for Concrete and Asphalt: Proprietary formulation composed of reactive petropolymer and activator components producing a pourable, self-leveling sealant with the following physical properties measured per ASTM D 3407.

### 2.5 CONCRETE MIX

- A. Mix concrete in accordance with ASTM C94 and ACI 301 Chapter 3.
- B. Cement Content: Type I or II cement, minimum of 564 pounds per cubic yard.
- C. Deliver concrete and discharge entire load within 1-1/2 hours, or before drum has turned 300 revolutions, whichever occurs first, after introduction of mixing water.



- D. During cold weather (below 45 degrees F.), use heated water and aggregates if necessary to maintain concrete temperature between 60 degrees F. and 90 degrees F.

### PART 3 - EXECUTION

#### 3.0 SUBGRADE

- A. Perform all cut and fill necessary to bring the subgrade within + 0.02' (1/4") of the bottom surface of sidewalks and other concrete work under this section.
- B. Cut or fill and finish grade as required to bottom of sidewalk or curb and gutter within a tolerance of 0.02' (1/4"). If fill is required, use Class 6 road base material compacted to at least 96% of Standard Proctor Density, ASTM D698. Class 6 road base shall have a liquid limit not greater than 30 and the following gradation:

<u>SIEVE SIZE</u>	<u>% PASSING</u>
3/4"	100
#4	30-65
#8	25-55
#200	3-12

- C. In no case shall variances from specified elevations create ponding or retain water on the finished surfaces.

#### 3.1 SIDEWALKS AND WALKWAYS

- A. General: Construct sidewalks, walkways and driveways in accordance with Local Standards.
- B. Finish: Broom finish unless otherwise indicated. Finish edges with a slightly rounded edging tool.
- C. Thickness: Total thickness of all sidewalks shall be a full 4" unless indicated otherwise.
- D. Main Entry: Construct with colored and textured concrete, as outlined on the Architectural Site Plan drawings and as specified below:
  - 1. Texture A: Grey concrete with a standard broom finish to match the surrounding campus sidewalks.
  - 2. Texture B: Grey concrete with light exposed sand finish or light sandblasted finish.
  - 3. Texture C: Concrete color to be coordinated with sandstone or stucco color of building and approved by Contracting Office prior to construction. Concrete finish to be light exposed sand or light sandblasted finish.

#### 3.2 FORMWORK ERECTION

- A. Verify lines, levels, and measurement before proceeding with formwork.
- B. Minimize form joints. Symmetrically align form joints and make watertight to prevent leakage of mortar. Install sufficient lengths of forms to allow continuous progress of work so that forms can remain in place at least 24 hours after concrete placement.

- C. Provide chamfer strips on external corners where detailed.
- D. Do not apply form release agent other than specified materials where concrete surfaces receive special finishes or applied coatings which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.
- E. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, dowels, anchors, and other inserts and embedded materials.
- F. Do not remove forms, shoring and bracing until concrete has sufficient strength to support its own weight, and construction and design loads which may be imposed upon it. Clean forms after each use, and coat with form oil as often as required to ensure separation from concrete without damage.
- G. During cold weather, remove ice and snow from forms. Do not use deicing salts. Do not use water to clean out completed forms unless formwork and construction proceed within heated enclosure. Use compressed air to remove foreign matter.

### 3.3 PLACING CONCRETE

- A. Contractor's Review: Contractor Quality Control shall inspect forms and reinforcing prior to concrete placement to assure accurate placement of embedded items. Inspection must be signed off by Contractor's Quality Control.
- B. Place concrete in accordance with ACI 301 and 304.
- C. Hot Weather Placement: ACI 301 and ACI 305.
- D. Cold Weather Placement: ACI 301 and ACI 306.
- E. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.
- F. Place concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur.
- G. Place concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section.
- H. If a section cannot be placed continuously, provide construction joint. Place concrete at such a rate that concrete which is being integrated with fresh concrete is still plastic. Avoid placement methods which produce segregation of the mix.
- I. Discard concrete which becomes non-plastic and unworkable, does not meet required quality control limits, or becomes contaminated with foreign materials.

- J. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding and tamping in accordance with ACI 309. Vibration of forms and reinforcing is not permitted.
- K. Roughen surfaces of set concrete at all joints, except where bonding agents are used. Clean surfaces of laitance, coatings, loose particles and foreign matter. Roughen surfaces in manner to expose bonded aggregate.
- L. Use bonding agent at joints between fresh concrete and existing or fully cured, hardened concrete. Apply bonding agent in accordance with manufacturer's instructions.
- M. Uniformly spread, screed, and float concrete. Do not use grate tampers or mesh rollers. Do not spread concrete by vibration.
- N. Control joints: Provide continuous control joints. In no case shall distance between joints, construction or control, exceed 15'-0". Provide depth of control joint equal to 1/4 slab depth.
- O. Separate slabs, curbs, manholes, and inlets from vertical surfaces with expansion joint material. Extend full depth of joint, and not less than 2 inch, nor more than 1 inch below finished surface where sealants are indicated.
- P. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Contracting Officer upon discovery.
- Q. Prior to placing, remove foreign materials. Broom and vacuum clean.
- R. Place dividers, edge strips, reinforcing and other items to be cast in.

### 3.4 JOINTS

- A. Construction control, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of the adjacent surface unless otherwise shown. Construct transverse joints to right angles of the adjacent surface centerline unless otherwise shown.
- B. When new construction is joining existing pavement, place transverse joints to align with previously place joints unless otherwise shown.
- C. Construction Joints: Place construction joints at the end of all pours and at locations where placement operations are stopped for a period of more than 1/2 hour, except where such pours terminate at expansion joints.
- D. Construct construction and control joints with materials and methods described herein.
- E. Expansion Joints: Provide 1/2 inch thick premolded joint filler for expansion joints and where new concrete abuts abutting catch basins, manholes, inlets, structures, walks and other fixed objects. Install expansion joints every 50 to 60 feet for 1/2 inch thick filler or 90 feet for 3/4 inch thick filler.

- F. In no case should control joints not be continuous through slab section from construction joint to construction joint. In no case shall dimension between joints, both construction and control, exceed 15 feet. Do not saw cut control joints.
- G. Extend joint fillers full width and depth of the joint, and not less than ½ inch or more than 1 inch below the finished surface. Furnish joint fillers in one-piece lengths for the full width being placed, wherever possible. Conform top edge of filler to top profile of sidewalks.
- H. Protect the top edge of the joint filler during concrete placement with a metal cap or other temporary material. Remove protection after both sides of joint are placed.
- I. Contraction Joints: Provide contraction joints as indicated on the drawings or specified. Provide scored joints with minimum depth of ¾ inch. Locate contraction joints where shown on the drawings. Locate contraction joints 10 feet on center in sidewalks unless indicated otherwise on the drawings.

### 3.5 CONCRETE FINISHING

- A. After striking off and consolidating concrete, smooth the exposed surface by screeding and floating. Adjust floating to compact the surface and produce a uniform texture.
- B. After completion of floating and when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
  - 1. Broom finish, by drawing a wet hair bottom across the concrete surface, in the direction of drainage, provide an abrasive, textured or otherwise slip-proof surface to all concrete slabs. Broom finish ramps perpendicular to slope.

### 3.6 CONCRETE CURING, PROTECTION AND SURFACE TREATMENTS

- A. General:
  - 1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of concrete.
  - 2. Curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing. The curing period shall be seven days for all concrete.
  - 3. Avoid rapid drying at the end of the curing period. During hot and cold weather, cure concrete in accordance with ACI 305 and ACI 306R.
- B. Curing Methods: Perform curing of concrete by moisture curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof. Coordinate with and choose a curing method that is compatible with the requirements for use of the concrete surface. Comply with the requirements of applicable portions of ACI Specifications 305 and 306R, as appropriate.
- C. Curing Formed Surfaces: Where wooden forms are used, cure formed concrete surfaces, by moist curing with forms in place for full curing period or until forms are removed. When forms are removed, continue curing by methods specified above for specified curing time.

- D. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs and other flat surfaces by application of appropriate curing method.

### 3.7 FORM REMOVAL

- A. Removal of Forms: Supplement and Modify ACI 301 as follows:
  - 1. ACI 301 4.5.4: Formwork not supporting weight of concrete such as sides of curbs, sidewalks and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing the concrete provided:
    - a. The concrete is sufficiently cured to be undamaged by form removal.
    - b. Required shores and supports are so arranged that they will not be loosened or disturbed during form removal.
    - c. Supplemental curing and protection is provided for exposed concrete surfaces.
- B. Backfilling: Backfill against all work following removal of forms. Fill level with surrounding area and compact as required in Section 02310. Final grade tolerance (+ 0.1').

### 3.8 REPAIR OF SURFACE DEFECTS

- A. Formed Surfaces:
  - 1. Inspect concrete surfaces immediately upon removal of forms.
  - 2. Modify or replace concrete not conforming to required lines, details and elevations.
  - 3. Repair or replace concrete not properly placed resulting in honeycombing and other defects.

### 3.9 TOLERANCES

- A. Formed Surfaces:
  - 1. Top of form units: Not more than 1/8" in 10'.
  - 2. Vertical face: Longitudinal axis, not more than 1/4" in 10'.
- B. Slab Finishing Tolerances:
  - 1. Slope to Drain: 1/8 inch per foot minimum.

### 3.10 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. Testing Laboratory: Sampling and testing for quality control during placement of concrete shall include the following.
  - 1. Slump: ASTM C143; at least one test at point of discharge for each day's pour of each type of concrete; additional tests at the inspector's discretion when concrete consistency seems to have changed.

Test when taking samples for compression tests.

- 2. Air Content: ASTM C173, volumetric method for normal weight concrete; ASTM C231 pressure method for normal weight concrete; at least one for each day's pour of each type of air-entrained concrete.

Test when taking samples for compression tests.

- 3. Concrete Temperature: Test hourly when air temperature is 40o F (4 degrees C) and below, and when 80o F (27 degrees C) and above; and each time a set of compression test specimens is made.

4. Compression Test Specimen: ASTM C31; one set of 3 standard cylinders for each compression strength test unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required. If additional cylinders are required by the Contractor for any reason, they shall be done at the contractor's expense.
- B. Compressive Strength Tests: ASTM C39; one set for each day's pour exceeding 5 cubic yards. One specimen tested at 7 days, One specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
    1. When frequency of testing will provide less than five strength tests for a given class of concrete (including flowable fill), conduct testing from at least five randomly selected batches of from each batch if fewer than five are used.
    2. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength by more than 500 psi.
  - C. Test results shall be submitted in writing to the Contracting Officer 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.
  - D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
  - E. Additional Tests: The Testing Agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure. Testing Agency shall conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42.

END OF SECTION 32 13 13

## SECTION 32 17 23 - PAVEMENT MARKING

### PART 1 - GENERAL

#### 1.0 SUMMARY

- A. This Section includes the following:
  - 1. Horizontal layout and control for pavement markings.
  - 2. Furnish and apply pavement markings in accordance with these specifications, the latest revision of the "Manual on Uniform Traffic Control Devices for Streets and Highways" published by the FHWA, and in close conformity to the lines, dimensions, patterns, locations and details shown on the Drawings.

#### 1.1 PROJECT CONDITIONS

- A. Construction Traffic: Conduct pavement marking operations to ensure minimum interference with roads, streets, walks, and other adjacent project areas under construction or temporary access.
- B. Protection of Existing Improvements: Provide protection necessary to prevent damage to newly installed improvements.
- C. Reference Standards: Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents.

#### 1.2 SUBMITTALS

- A. Certificate of Conformance: Submit three copies of the manufacturer's certificate of conformance and application preparation requirements for the products to be used on this project.

### PART 2 - PRODUCTS

#### 2.0 PAVEMENT MARKING PAINT

- A. Pavement marking paint shall be a White Latex Traffic Paint 21209 by Glidden, or set fast Acrylic Waterborne Traffic Marking Paint by Sherwin Williams, or equal.

### PART 3 - EXECUTION

#### 3.0 PAVEMENT MARKING WITH PAINT

- A. Striping shall be done during daylight hours when the air and pavement temperatures are at least 40 Deg F. The pavement surface and weather conditions shall be conducive to satisfactory results. Surface shall be cleaned by a method to provide a satisfactory bonding surface.
- B. Layout work in conformity to the plan dimensions.
- C. Equipment shall be capable of painting a reasonably clean-edge stripe of the designated width. In areas here machine are not practical, suitable hand-operated equipment shall be used. Stripes shall be protected until dry.
- D. Paint shall be applied within the following limits:

1. Application Rate or Coverage Per Gallon of Paint:

Minimum

Maximum

Paint: 100 square feet

110 square feet

3.1 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work of this Section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

END OF SECTION 32 17 23



## SECTION 33 11 00 – WATER UTILITY DISTRIBUTION PIPING

### PART 1 - GENERAL

#### 1.0 SUMMARY

- A. Section Includes: Testing water systems.
- B. Related Sections:
  - 1. Section 31 23 17: Trenching

### PART 2 - PRODUCTS

#### 2.0 MATERIALS

- A. Water Used for Testing: Shall be suitable for drinking unless otherwise approved in writing by the Contracting Officer before use.

#### 2.1 EQUIPMENT

- A. Requirements: Pressure gauges used shall be graduated in increments not greater than 5 pounds per square inch and shall have a range of approximately twice the test pressure. Use gauges and instruments which have been calibrated within  $\pm 2$  psi.

### PART 3 - EXECUTION

#### 3.0 GENERAL

- A. Testing: Conduct the performance and acceptance tests of the piping systems. Furnish necessary equipment, labor, and materials to conduct the testing. Testing shall be conducted in the presence of the Contracting Officer.
- B. Notification: Notify the Contracting Officer at least 48 hours prior to testing.
- C. Procedure: Prior to testing, remove from the systems, equipment which would be damaged by the test pressure. Ensure thrust blocks have sufficiently hardened. Replace removed equipment after testing. Systems may be tested in sections as work progresses; however, previously tested portions shall become a part of the later test of the composite system. If water enters the trench when pressure testing with water, locate the leak in the line. If the leak cannot be located, dewater the trench or air-test the line. When the line has been repaired, repeat the 2-hour water test. Repair leaks. Test time will be accrued only while full test pressure is exerted or subjected on the system. Prepare and brace the line according to the manufacturer's instructions. Maintain trenches according to OSHA 2207 and Section 31 23 17 - Trenching, until testing and pipe repair is completed.

- D. Backfilling: Complete testing and secure approval of Contracting Officer prior to backfilling or concealing lines. Backfilling shall be according to Section 31 23 17 - Trenching.

### 3.1 WATER LINES

- A. Filling Water Line: Fill line with water and eliminate air in the line. Do not fill the pipeline at a velocity greater than 1 foot per second.
- B. Test Pressure: After the pipeline and appurtenances and tanks, are in place, fill with water and subject to the test. Maintain pressure of 150 percent of maximum anticipated operating pressure or the maximum working pressure of the pipe, whichever is less, on the section being tested, for a minimum period of 2 hrs. Fill the section with water for a period of at least 24 hrs. After repairing leaks, test as previously described for 24 consecutive hrs. The pipeline shall show no loss or leaks. Maintain pressure by either hydraulic or pneumatic means.
- C. Leakage: Maximum leakage during the test shall not exceed 1 gallon per inch of pipe diameter, per 1,000 feet of pipe. Visible leakage, other than a minor amount of sweating, shall require immediate stoppage of the test and tightening of the pipe joints so when pressure is again applied to the system, there shall be no leakage. Do not use paints, asphalts, tars, or other types of pipe compounds to eliminate leaks. Replace leaking valves, fittings, nipples, or lengths of pipes.

END OF SECTION 33 11 00

## SECTION 33 12 16 - VALVES

### PART 1 – GENERAL

#### 1.0 SUMMARY

- A. Section Includes: Furnishing and Installing valves, and fittings with valve boxes.

#### 1.1 SUBMITTALS

- A. Manufacturer's Literature: Submit three copies of the manufacturer's descriptive data for the valves to be used on this project.
- B. Installation Instructions: Submit three copies of the manufacturer's installation instructions for the valves to be used on this project.

### PART 2: PRODUCTS

#### 2.0 COMPONENTS

- A. Valves: Valves shall have a minimum pressure rating 200 psi and be the same size as the connecting pipeline, unless otherwise noted on the drawings.
  - 1. Gate Valves: Cast iron body, pressure rating of 200 psi, bronze mounted, complying with AWWA C 500, with solid bronze double discs, parallel seats, and nonrising stems with push on, flanged, or mechanical joint as required. Valves with ring stem seal shall have 2" square operating nut, open left.
  - 2. Check Valves: 2 inch and larger ball check valves shall be as manufactured by ITT Flygt (Type 5087) or approved equal.
  - 3. Surge Valve: Globe Surge Relief Valve, Valve to be APCO Series 6500 Globe Surge Relief Valve, as manufactured by Valve & Primer Corporation or approved equal.
- B. Valve Boxes: Each gate valve on buried piping shall be provided with an adjustable valve box of a size suitable for the valve that is acceptable to the Kane County's Utility Department. Valve box shall be of sufficient length, when properly installed, to permit adjustment to at least 3 inches above the final ground surface elevation. Valve boxes shall be of proper size for the required valves and equipped with lid, extension pieces, and such springs, bases, base plates, and other appurtenances as are required to complete each box. The head shall be round and the cover shall have the letter "W" cast on it. The least diameter of the box shaft shall be 5-1/4 inches.

#### 2.1 ACCESSORIES

- A. Tools: Furnish valve keys, shut-off rods, or other tools to operate valves and open the top of valve boxes. A minimum of one of each such tool shall be furnished for each style and size installed.

#### 2.2 THRUST BLOCK MIXES

- A. Concrete: As specified in Section 033000.

### PART 3 - EXECUTION

### 3.0 INSTALLATION

- A. Valve and Box:
  - 1. Valves: Shall be installed so that each will function freely and no parts are strained.
  - 2. Frame and Cover: Install as indicated on the drawings. Unless otherwise indicated on the drawings, the top of the cover shall be flush with the finished grade.
- B. Concrete Support Block: When indicated on the drawings shall be installed and based to such depth as necessary to prevent heaving from frost action.
- C. Pipe Connections: Extend sufficiently beyond the outside face of the box to permit ready connection. Extend a minimum of 5 feet from center of valve box.
- D. Thrust Blocks: Provide concrete thrust blocks at changes in direction of the piping, under gate valves and other accessories with the bearing surface against undisturbed soil normal to the direction of the thrust.
- E. Valves and Valve Boxes: Valves and valve boxes shall be set plumb, with valve boxes centered directly over the valves and base section firmly screwed to stop or resting on cast iron foot piece, cement block, or compacted backfill. Set top section to allow equal movement above and below finished grade. Final elevation to be as approved by the Contracting Officer. Valve boxes shall be located outside the area of the roads and streets whenever possible. Earth fill shall be tamped around the valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet. Clean foreign matter from interior of valves before installation. Stuffing boxes shall be tightened and the valve shall be inspected in open and closed positions to ensure that the parts are in proper working order.

END OF SECTION 33 12 16

## SECTION 33 31 00 – SANITARY UTILITY SEWERAGE UTILITIES

### PART 1 - GENERAL

#### 1.0 SUMMARY

- A. Section Includes: Testing gravity sewer systems.
- B. Related Sections:
  - 1. Section 31 23 17: Trenching

### PART 2 - PRODUCTS

#### 2.0 MATERIALS

- A. Water Used for Testing: Shall be suitable for drinking unless otherwise approved in writing by the Contracting Officer before use.

#### 2.1 EQUIPMENT

- A. Requirements: Pressure gauges used shall be graduated in increments not greater than 5 pounds per square inch and shall have a range of approximately twice the test pressure. Use gauges and instruments which have been calibrated within  $\pm 2$  psi.

### PART 3 - EXECUTION

#### 3.0 GENERAL

- A. Testing: Conduct the performance and acceptance tests of the piping systems. Furnish necessary equipment, labor, and materials to conduct the testing. Testing shall be conducted in the presence of the Contracting Officer.
- B. Notification: Notify the Contracting Officer at least 48 hours prior to testing.
- C. Procedure: Prior to testing, remove from the systems, equipment which would be damaged by the test pressure. Ensure thrust blocks have sufficiently hardened. Replace removed equipment after testing. Systems may be tested in sections as work progresses; however, previously tested portions shall become a part of the later test of the composite system. If water enters the trench when pressure testing with water, locate the leak in the line. If the leak cannot be located, dewater the trench or air-test the line. When the line has been repaired, repeat the 2-hour water test. Repair leaks. Test time will be accrued only while full test pressure is exerted or subjected on the system. Prepare and brace the line according to the manufacturer's instructions. Maintain trenches according to OSHA 2207 and Section 31 23 17 - Trenching, until testing and pipe repair is completed.

- D. Backfilling: Complete testing and secure approval of Contracting Officer prior to backfilling or concealing lines. Backfilling shall be according to Section 31 23 17 - Trenching.

### 3.1 GRAVITY SEWER

- A. General: Perform water- or air-leakage tests as specified below. Where ground water is encountered, make infiltration tests as specified below. A finished plumbing test, as indicated below, shall be performed on building gravity sewer lines, drain lines, and vent systems.

- B. Tests for Lines Located Inside Buildings and Within 2 Feet of the Building Perimeter:

1. Water Test: The water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, openings in the piping shall be tightly closed, except the highest opening. The system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest opening of the section under test. Each section shall be filled with water, but no section shall be tested with less than a 10-foot head of water. In testing successive sections, at least the upper 10 feet of the next-preceding section shall be tested, so that no joint or pipe in the building (except the uppermost 10 feet of the system) shall have been subjected to a test of less than a 10-foot head of water. The water shall remain in the system, or in the portion under test, for at least 15 min before inspection starts. The system shall not leak. The test-water level shall be maintained to within 6 inches during the test period.
2. Air Test: The air test shall be made by attaching an air-compressor testing apparatus to a suitable opening. After closing other inlets and outlets to the system, force air into the system until there is a uniform gauge pressure of 5 pounds per square inch, or sufficient pressure to balance a column of mercury 10 inches in height. This pressure shall be maintained without introduction of additional air for at least 15 minutes.
3. Finished Plumbing: After the plumbing fixtures have been installed and the traps filled with water, the connections shall be tested and proved watertight. This test shall consist of flushing water closets and discharging full fixtures through the system.

- C. Tests for Lines Located Outside of Buildings and Beyond 2 Feet of Building Perimeter:

1. Exfiltration Test: Make leakage test upon the completion of each pipe section between manholes by closing the lower end of the section to be tested and the inlet sewer of the upper manhole with stoppers. Fill the pipe and manhole, or standpipe, if manhole is not in place, with water to a point 7 feet above the invert of the open sewer in the upper manhole. Maximum-allowable leakage shall not exceed 100 gallons per 24-hour day, per inch of diameter, per mile of sewer being tested. Minimum duration of this test shall be 24 hrs. Overhaul when leakage in excess of this amount is detected before completion and acceptance of the sewer. When necessary, re-lay the sewer until the leakage is reduced to a quantity within the specified amount. When the leakage is less than the specified amount, check, repair, and stop visible leaks. The test-water level shall be maintained to within 6 inches during the period of the test.
2. Infiltration Test: Make infiltration tests in areas where ground water is encountered. These tests shall be made upon the completion of each section between manholes by closing the end of the sewer at the upper manhole to prevent the entrance of water. Infiltration shall not exceed 100 gallons per 24 hour day, per inch of diameter, per mile of sewer being tested. Minimum duration of this test shall be 24 hours. Where infiltration in excess of this amount is detected before completion and acceptance of the sewer, uncover

the sewer and reduce the amount of the infiltration to a quantity within the specified amount. If the infiltration is less than the specified amount, check, repair, and stop visible leaks.

3. Air Testing: The minimum time requirements for air testing for the pressure drop, from 3.5 to 2.5 psig, shall not be less than shown below:

<u>Nominal Pipe Size (Inches)</u>	<u>Time</u>
4	2 min 0
6	2 min 15
8	3 min 57

Should a test on sections of pipeline exceed an air loss rate greater than that permitted, locate and repair the defective joints or pipes and retest until the air loss rate is within the specified allowance as shown in the table above.

4. Light Test: Light held in pipe at one manhole shall be visible from next manhole as a full circle of light.

END OF SECTION 33 31 00

Architect's and Consultant's  
Specification Guide

For

**Otis Elevator Company**

**HydroFit**<sup>TM</sup>

**Machine-Room Less Hole-Less Hydraulic Elevator**

For

**Window Rock Office Building**

Prepared according to  
**Construction Specifications Institute (CSI)**



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## ELEVATORS 14240 – Guide Specifications for HydroFit Hydraulic Elevator

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### SECTION 14240 – Hydraulic Elevators

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section specifies hydraulic elevators.
- B. Work Required:
  - 1. The work required under this section consists of all labor, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevator(s) as herein specified.
  - 2. All work shall be performed in a first class, safe and workmanlike manner.
  - 3. In all cases where a device or part of the equipment is herein referred to in the singular, it is intended that such reference shall apply to as many of such devices or parts as are required to make complete installation.
- C. Related work not specified herein: The following sections contain requirements that relate to this section and are performed by trades other than the elevator manufacturer/installer.
  - 1. **Section 01500 - Construction Facilities and Temporary Controls:** protection of floor openings and personnel barriers; temporary power and lighting.
  - 2. **Section 02200 - Earthwork:** excavation for cylinder well casing.
  - 3. **Section 03300 - Cast-In-Place Concrete:** elevator pit, elevator motor and pump foundation, and grouting thresholds.
  - 4. **Section 04200 - Unit Masonry:** masonry hoistway enclosure, building-in and grouting hoistway door frames, grouting thresholds.
  - 5. **Section 05500 - Metal Fabrications:** pit ladder, divider beams, support for entrances and rails, hoisting beam at top of hoistway.
  - 6. Section 07145 - **Cementitious Waterproofing:** waterproofing of elevator pit.
  - 7. **Section 16100 - Electrical:** **Section 16100 - Electrical:**
    - a. Main disconnects for each elevator.
    - b. Electrical power for elevator installation and testing.
    - c. Disconnecting device to elevator equipment prior to activation of sprinkler system.
    - d. The installation of dedicated GFCI receptacles in the pit and overhead.
    - e. Lighting in controller area, machine area and pit.
    - f. Wiring for telephone service to controller.
  - 8. **Section 16610 - Standby Power Supply Systems:** emergency generator for elevator operation.
  - 9. **Section 16720 - Fire Alarm Systems:** fire and smoke detectors and interconnecting devices; fire alarm signal lines to contacts in the machine area.
  - 10. **Section 16740 - Telephone Systems:** ADAAG-required emergency communications equipment.
- D. Applicable Codes: Comply with applicable building and elevator codes at the project site, including but not limited to the following:
  - 1. ANSI A117.1, Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People.
  - 2. ADAAG, Americans with Disabilities Act Accessibility Guidelines.
  - 3. ANSI/NFPA 70, National Electrical Code.
  - 4. ANSI/NFPA 80, Fire Doors and Windows.
  - 5. ASME/ANSI A17.7, Safety Code for Elevators and Escalators.
  - 6. ANSI/UL 10B, Fire Tests of Door Assemblies.

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## ELEVATORS 14240 – Guide Specifications for HydroFit Hydraulic Elevator

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7. CAN/CSA C22.1, Canadian Electrical Code.
8. CAN/CSA-B44, Safety Code for Elevators and Escalators.
9. EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity"
10. Local Building Codes.
11. All other local applicable codes.

### [NOTE: EDIT ITEMS SHOWN IN [BOLD] TEXT]

#### 1.02 SYSTEM DESCRIPTION

*Note: Create separate sections, each containing the following parameters, if a group contains more than one system configuration.*

- A. Equipment Description: Holeless Hydraulic elevator with Machine-Room Less application
- B. Equipment Control: Elevonic® Control System.
- C. Quantity of Elevators: 1
- D. Elevator Stop Designations: 1,2,3
- E. Stops : 3
- F. Openings: 3 at Front, 0 at Rear.
- G. Travel: 23 ft 0 in 0
- H. Rated Capacity: 2100 lbs
- I. Rated Speed: 100 fpm
- J. Platform Size: 5' 9-1/2" wide x 4' 11-1/8" deep
- K. Clear Inside Dimensions: 5' 8 5/16" x 4' 3 9/16"
- L. Cab Height: 7' 9"
- M. Clear Cab Height: 7'-9" with 5/16" floor recess and Structural ceiling
- N. Entrance Type and Width: Entrance Type and Width: Single Slide; 3' 0"
- O. Entrance Height: 7' 0"
- P. Main Power Supply: 480 Volts, 3-Phase, 60Hz + or - 5% of normal, three-Phase, with a separate equipment grounding conductor.
- Q. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.
- R. Machine and Controller Location: No machine-room required, tank and controller in hoistway pit.
- S. Signal Fixtures: Manufacturer's standard with stainless steel metal button targets (exc. CA).
- T. Controller Location: Inside hoistway, accessible by a door in the left side hoistway wall on the 1<sup>st</sup> or 2<sup>nd</sup> landing. (1<sup>st</sup> landing only if rear entrance)
- U. Stopping Accuracy: ±1/4" (6.4 mm) under any loading condition or direction of travel.
- V. Operation: Simplex Collective Operation- Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.

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## ELEVATORS 14240 – Guide Specifications for HydroFit Hydraulic Elevator

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- W. Operating Features – Standard
1. Full Collective Operation
  2. Anti-nuisance.
  3. Fan and Light Protection.
  4. Load Weighing Bypass.
  5. Independent Service.
  6. Full Collective Operation.
  7. Firefighters' Service Phase I and Phase II **(USA only)**;
  8. Top of Car Inspection.
- X. Operation Features – Optional
1. Zoned Access at Bottom Landing.
- Y. Door Control Features:
1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
  2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.  
Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening.
  3. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.
- Z. Provide equipment according to seismic zone: Zone 1

### 1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:
1. Signal and operating fixtures, operating panels and indicators.
  2. Cab design, dimensions and layout.
  3. Hoistway-door and frame details.
  4. Electrical characteristics and connection requirements.
  5. Expected heat dissipation of elevator equipment in hoistway (BTU).
  6. Color selection chart for Cab and Entrances.
- B. Shop Drawings: Submit approval layout drawings. Include the following:
1. Car, guide rails, buffers and other components in hoistway.
  2. Maximum rail bracket spacing.
  3. Maximum loads imposed on guide rails requiring load transfer to building structure.
  4. Clearances and travel of car.
  5. Clear inside hoistway and pit dimensions.
  6. Location and sizes of access doors, hoistway entrances and frames.
- C. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

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## ELEVATORS 14240 – Guide Specifications for HydroFit Hydraulic Elevator

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### 1.04 QUALITY ASSURANCE

- A. Manufacturer: Elevator manufacturer shall be ISO 9001 certified.
- B. Installer: Elevators shall be installed by the manufacturer.
- C. Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permit as required by the elevator inspection authority, and make such tests as are called for by the regulations or such authorities. These tests shall be made in the presence of such authorities or their authorized representatives.

### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor will be responsible to provide a proper and suitable storage area on or off the premises.

Should the storage area be off-site and the equipment not yet delivered, then the elevator contractor, upon notification from the General Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the General Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage, and redeliver to the job site shall not be at the expense of the elevator contractor.

### 1.06 WARRANTY

- A. The elevator contractor's acceptance is conditional on the understanding that their warranty covers defective material and workmanship. The warranty period shall not extend longer than one (1) year from the date of completion or acceptance thereof by beneficial use, whichever is earlier, of each elevator. The warranty excludes: ordinary wear and tear, improper use, vandalism, abuse, misuse, or neglect or any other causes beyond the control of the elevator contractor and this express warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

### 1.07 MAINTENANCE and SERVICE

- A. Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided by the elevator contractor for a period of 12 Months months after the elevator has been turned over for the customer's use. This service shall not be subcontracted but shall be performed by the elevator contractor. All work shall be performed by competent employees during regular working hours of regular working days. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.
- B. The elevator control system must:
  - 1) Provide in the controller the necessary devices to run the elevator on inspection operation.
  - 2) Provide on top of the car the necessary devices to run the elevator in inspection operation.
  - 3) Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.
  - 4) **[Optional]** Provide the means from the controller to reset elevator earthquake operation.

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## ELEVATORS 14240 – Guide Specifications for HydroFit Hydraulic Elevator

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- C. Provide system capabilities to enable a remote expert to create a live, interactive connection with the elevator system to enable the following functions:
1. Remotely diagnose elevator issues with a remote team of experts
  2. Remotely return an elevator to service
  3. Provide real-time status updates via email
  4. Remotely make changes to selected elevator functions including:
    - a. Control building traffic: Restrict floor access, remove car from group operation, shut down elevator, select up peak / down peak mode, activate independent service
    - b. Conserve energy: Activate cab light energy save mode, activate fan energy save mode, shut down car(s)
    - c. Improve passenger experience: Extend door open times, change parking floor, activate auto car full, activate anti-nuisance, advance door opening, door nudging, extend specific floor extended opening time, release trapped passengers

### PART 2 - PRODUCTS

#### 2.01 DESIGN AND SPECIFICATIONS

- A. Provide machine-roomless holeless hydraulic elevators from Otis Elevator Company. The control system and car design based on materials and systems manufactured by Otis Elevator Company. Specifically, the system shall consist of the following components:
1. The entire hydraulic system and the controller shall be located inside the hoistway. No extra machine room or control closet space is required.
  2. Sleep mode operation for LED ceiling lights and car fan.
  3. LED lighting standard in ceiling lights and elevator fixtures.
  4. Sleep mode operation for LED ceiling lights and car fan.
- B. Approved Installer: Otis Elevator

#### 2.02 EQUIPMENT: MACHINE COMPONENTS

- A. The hydraulic system shall be of compact design suitable for operation under the required pressure. The power component shall be mounted in the hydraulic-fluid storage tank. The control valve shall control flow for up and down directions hydraulically and shall include an integral check valve. A control section including control solenoids shall direct the main valve and control: up and down starting, acceleration, transition from full speed to leveling speed, up and down stops, pressure relief and manual lowering. All of these functions shall be fully adjustable for maximum smoothness and to meet contract conditions. System to be provided with a low-pressure switch and a shut-off valve.  
The entire hydraulic system with hydraulic-fluid storage tank, power component and valves shall be located in the hoistway pit and be easily accessible for maintenance through an access door in the hoistway wall.
- B. A microprocessor-based controller shall be provided, including necessary starting switches together with all relays, switches, solid-state components and hardware required for operation,

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## ELEVATORS 14240 – Guide Specifications for HydroFit Hydraulic Elevator

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including door operation, as described herein. A three (3) phase overload device shall be provided to protect the motor against overloading.

The controller shall be located together with the hydraulic system in the hoistway pit and be easily accessible for maintenance through the same access door that is also used for the hydraulic system.

- C. A manual lowering feature shall permit lowering the elevator at slow speed in the event of power failure or for adjusting purposes.
- D. Pressure Switch
- F. Low-oil control

### 2.03 EQUIPMENT: HOISTWAY COMPONENTS

- A. Plunger(s) and Cylinder(s): Each cylinder shall be constructed of steel pipe of sufficient thickness and suitable for the operating pressure. The top of each cylinder shall be equipped with a cylinder head with a drip ring to collect any oil seepage as well as an internal guide ring and self-adjusting packing. Each plunger shall be constructed of selected steel tubing or pipe of proper diameter machined true and smooth with a fine polished finish. Each plunger shall be provided with a stop ring electrically welded to it to prevent the plunger from leaving the cylinder. Each plunger and cylinder shall be installed plumb and shall operate freely with minimum friction.
- B. Car Guide Rails: Tee-section steel rails with brackets and fasteners.
- C. Polyurethane type buffers shall be used.
- C. Wiring: Wiring for hoistway electrical devices included in scope of the elevator system, hall panels, pit emergency stop switch, and the traveling cable for the elevator car.
- D. Hoistway Entrances
  - 1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
  - 2. Sills shall be extruded Aluminum.
  - 3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
  - 4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour
  - 5. Entrance Finish: Satin Stainless Steel
  - 6. Entrance marking plates: Entrance jambs shall be marked with 4" x 4" (102 mm x 102 mm) plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
  - 7. Sight Guards: Black sight guards will be furnished with all doors.

### 2.04 EQUIPMENT: CAR COMPONENTS

- A. Cab: Steel shell cab with raised laminate panels. Laminate to be selected from standard manufacturer's catalog of choices. Brushed Steel Finish finished base plate located at top and bottom.

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## ELEVATORS 14240 – Guide Specifications for HydroFit Hydraulic Elevator

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- B. Car Front Finish: Satin Stainless Steel
- C. Car Door Finish: Satin Stainless Steel
- D. Ceiling Type: Flush steel ceiling with 4 LED lights in a brushed steel finish.
- E. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car in the event of building power failure.
- F. Fan: A one-speed 120 VAC fan will be mounted to the structural ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.
- G. Handrail: Handrails shall be 3/8" x 2" (9.5 mm x 51 mm) flat tubular handrail with a brushed steel finish.  
Handrails shall be provided on the rear of the car enclosure.
- H. Threshold: Extruded Aluminum
- I. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.
- J. Guides: Car roller type guides at the top and the bottom.
- K. Platform: Car platform shall be constructed of metal.
- L. The LED ceiling lights and the fan should automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.

### 2.05 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

- A. Car Operating Panel: A standard car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a Satin Stainless Steel finish.

A car operating panel shall be furnished. It shall contain a bank of round stainless steel, mechanical LED illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings with:

1/8" (3mm) satin stainless steel projecting button with blue or white LED illuminating halo.

The car operating panel shall be equipped with the following features:

1. Raised markings and Braille to the left hand side of each push-button.
2. Car Position Indicator at the top of and integral to the car operating panel.
3. Door open and door close buttons.
4. Inspection key-switch.
5. Elevator Data Plate marked with elevator capacity and car number.
6. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
7. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.

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## ELEVATORS 14240 – Guide Specifications for HydroFit Hydraulic Elevator

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Standard for USA, Optional in Canada

8. In car stop switch (toggle or key unless local code prohibits use)
9. Firefighter's hat (standard USA)
10. Firefighter's Phase II Key-switch (standard USA)
11. Call Cancel Button (standard USA)

Optional

1. Firefighter's Phase II Emergency In-Car Operating Instructions: worded according to A17.1 2000, Article 2.27.7.2.
2. Please Exit Symbol: provided with emergency hospital service, Seismic Zones  $\geq 2$  or express priority in the hall.

- B. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.
- C. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Integral Hall fixtures shall feature round stainless steel, mechanical buttons marked to correspond to the landings. Hall fixtures to be located in the wall. Buttons shall be in vertically mounted fixture. Fixture shall be Satin Stainless Steel.  
  
Button Options: 1/8" (3mm) satin stainless steel projecting button with blue or white LED illuminating halo.
- D. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound.
- E. Access key-switch at top floor in entrance jamb.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

#### 3.02 INSTALLATION

- A. Installation of all elevator components except as specifically provided for elsewhere by others.

#### 3.03 DEMONSTRATION

- A. The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

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