Contact Documents and Specifications

FOR

Golden Age Manor First Floor Improvements & Accessible Front Entrance

400 Walnut Street, Royersford, PA 19468

Owner:
Montgomery County Housing Authority
501 East High Street
Pottstown, PA 19464

Date: October 2026
Project #: 1091224.005

400 Cresson Boulevard, Suites 105A & 108A, Phoenixville, PA 19460 | 610.935.2175

Headquartered in Allentown | 10 Regional Offices
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4 Construction Materials Testing Labs
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BARRY ISETT & associates INC
MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

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BARRY ISETT & associates INC
MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 01

General Requirements

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Contractor’s use of site and premises.
5. Work performed by Owner.
6. Contractor's use of site and premises.
7. Coordination with occupants.
8. Work restrictions.
9. Specification and Drawing conventions.

1.3 PROJECT INFORMATION

A. Project Identification: Montgomery County Housing Authority (MCHA)
Golden Age Manor First Floor Improvements & Accessible Front Entrance and Related Work

1. Project Location: 400 Walnut Street
Royersford, PA 19468

B. Owner: Montgomery County Housing Authority
Attn: Becky Schaeffer, Manager of Capital Projects
501 E. High Street, Pottstown, PA 19464
bschaeffer@montcoha.org

C. Engineer: Barry Isett & Associates, Inc.
Attn: Matthew Carpenter, Assoc. AIA
400 Cresson Blvd Suites 105-108
Phoenixville, PA 19460
mcarpenter@barryisett.com

D. Architect: Marotta/Main Architects
Attn: Ted L. Strosser, AIA
214 N. 4th Street
Lancaster, PA 17602
TLS@MarottaMain.com

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. All labor, materials, oversight, bonds, and permits required to furnish and install indicated interior and exterior improvements.

B. Type of Contract:

1. Project will be constructed under coordinated, concurrent multiple contracts. See Section 011200 "Multiple Contract Summary" for a list of multiple contracts, a description of work included under each of the multiple contracts, and the responsibilities of Project coordinator.

1.5 PHASED CONSTRUCTION

A. Construct the Work in (2) phases, with each phase substantially complete as indicated in Division 00 specifications.

1. Phase 1: Asbestos Abatement. General Contractor to perform Asbestos Abatement portion of the work in compliance with documents provided by Batta Environmental Associates, Inc.

2. Phase 2: All other indicated interior and exterior improvements.

Before commencing Work, submit an updated copy of Contractor's construction schedule, showing the sequence, commencement and completion date for all of the Work.

1.6 WORK PACKAGE

A. Construction Documents for this Project will be issued in one package, with defined scope of work per Prime Contractor.

1.7 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy Project site and **existing** building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used

facilities without written permission from Owner and approval of authorities having jurisdiction.

2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.8 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 7:00 a.m. to 3:30 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Owner and Engineer not less than two days in advance of proposed utility interruptions.

2. Obtain Owner’s written permission before proceeding with utility interruptions.

D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner and Engineer not less than two days in advance of proposed disruptive operations.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

A. 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. Imperative mood and streamlined language are generally used in the Specifications. 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.

2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 011200 - MULTIPLE CONTRACT SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a summary of each contract, including responsibilities for coordination and temporary facilities and controls.

B. Specific requirements for Work of each contract are also indicated in individual Specification Sections and on Drawings.

C. Related Requirements:

1. Section 011000 "Summary" for the Work covered by the Contract Documents, restrictions on use of Project site, phased construction, coordination with occupants, and work restrictions.

2. Section 013100 "Project Management and Coordination" for general coordination requirements.

1.2 PROJECT COORDINATOR

A. General Construction Contract shall be identified as the Project Coordinator.

B. Project coordinator shall be responsible for coordination between the work of its contract and the Plumbing Contract, Mechanical Contract, Electrical Contract.

1.3 PROJECT COORDINATOR RESPONSIBILITIES

A. Project coordinator shall perform Project coordination activities for the multiple contracts, including, but not limited to, the following:

1. Provide typical overall coordination of the Work.

2. Coordinate shared access to workspaces.

3. Coordinate product selections for compatibility.

4. Provide overall coordination of temporary facilities and controls.

5. Coordinate, schedule, and approve interruptions of permanent and temporary utilities, including those necessary to make connections for temporary services.

6. Coordinate construction and operations of the Work with work performed by each Contract.

7. Prepare coordination drawings in collaboration with each contractor to coordinate work by more than one contract.

8. Coordinate sequencing and scheduling of the Work.

    a. Prepare combined Contractors' Construction Schedule for entire Project Base schedule on preliminary construction schedule. Secure time commitments for performing critical construction activities from contractors. Show activities of each contract on a separate sheet. Prepare a simplified summary sheet indicating combined construction activities of contracts.

        1) Submit schedules for approval.

        2) Distribute copies of approved schedules to contractors.

9. Provide information necessary to adjust, move, or relocate existing utility structures affected by construction.
10. Locate existing permanent benchmarks, control points, and similar reference points, and establish permanent benchmarks on Project site.
11. Provide field surveys of in-progress construction and site work.
12. Provide progress cleaning of common areas and coordinate progress cleaning of areas or pieces of equipment where more than one contractor has worked.
13. Coordinate cutting and patching.
14. Coordinate protection of the Work.
15. Coordinate firestopping.
16. Coordinate completion of interrelated punch list items.
17. Coordinate preparation of Project Record Documents if information from more than one contractor is to be integrated with information from other contractors to form one combined record.
18. Print and submit Record Documents if installations by more than one contractor are indicated on the same Contract Drawing or Shop Drawing.
19. Coordinate preparation of operation and maintenance manuals if information from more than one contractor is to be integrated with information from other contractors to form one combined record.

B. Responsibilities of Project coordinator for temporary facilities and controls include, but are not limited to, the following:

1. Provide common-use field office for use by all personnel engaged in construction activities.

2. Provide temporary sanitary facilities for use by all personnel engaged in construction activities.

1.4 GENERAL REQUIREMENTS OF CONTRACTS

A. Extent of Contract: Unless the Agreement contains a more specific description of the Work of each Contract, requirements indicated on Drawings and in Specification Sections determine which contract includes a specific element of Project.

1. Unless otherwise indicated, the work described in this Section for each contract shall be complete systems and assemblies, including products, components, accessories, and installation required by the Contract Documents.

2. Trenches and other excavation for the work of each contract shall be the work of each contract for its own work.

3. Blocking, backing panels, sleeves, and metal fabrication supports for the work of each contract shall be the work of each contract for its own work.

4. Furnishing of access panels for the work of each contract shall be the work of each contract for its own work. Installation of access panels shall be the work of each contract for its own work.

5. Equipment pads for the work of each contract shall be the work of each contract for its own work.

6. Roof-mounted equipment curbs for the work of each contract shall be the work of each contract for its own work.

7. Painting for the work of each contract shall be the work of the General Construction Contract .

8. Cutting and Patching shall be the work of each contract for its own work.

9. Through-penetration firestopping for the work of each contract shall be provided by each contract for its own work.

10. Coordinate sequence of activities to accommodate tests and inspections, and coordinate schedule of tests and inspections of each contract.

11. Contractors' Startup Construction Schedule: Within five working days after startup horizontal bar-chart-type construction schedule submittal has been received from Project coordinator, submit a matching startup horizontal bar-chart schedule showing construction operations sequenced and coordinated with overall construction.

B. Substitutions: Each contractor shall cooperate with other contractors involved to coordinate approved substitutions with remainder of the work.

1. The Project Coordinator shall coordinate substitutions in accordance with Section 012500 “Substitution Procedures.”

C. Temporary Facilities and Controls: In addition to specific responsibilities for temporary facilities and controls indicated in this Section and in Section 015000 "Temporary Facilities and Controls," each contractor is responsible for the following:

1. Installation, operation, maintenance, and removal of each temporary facility necessary for its own normal construction activity, and costs and use charges associated with each facility, except as otherwise provided for in this Section.

2. Plug-in electric power cords and extension cords, supplementary plug-in task lighting, and special lighting necessary exclusively for its own activities.

3. Its own field office, complete with necessary furniture, and utilities.

4. Its own storage and fabrication units.

5. Temporary enclosures for its own construction activities.

6. Staging and scaffolding for its own construction activities.

7. General hoisting facilities for its own construction activities.

8. Waste disposal facilities, including collection and legal disposal of its own hazardous, dangerous, unsanitary, or other harmful waste materials.

9. Progress cleaning of work areas affected by its operations on a daily basis.

10. Secure lockup of its own tools, materials, and equipment.

11. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.

D. Temporary Heating, Cooling, and Ventilation: The General Construction Contract is responsible for temporary heating, cooling, and ventilation, including utility-use charges, temporary meters, and temporary connections.

1.5 GENERAL CONSTRUCTION CONTRACT

A. Work of the General Construction Contract includes, but is not limited to, the following:

1. Project Coordinator responsibilities as listed above.

2. All work indicated on Drawings CS-1 through DD1.15 not indicated to be performed by another prime contract.

3. All work indicated on the Abatement Drawings.

4. All work indicated in the Division 01-12 and 31-33 specifications.

5. Remaining work not identified as work under other contracts.

6. Site preparation, including clearing, building demolition and relocations, and earthwork.

7. Site improvements, including roadways, parking lots, pedestrian paving, site development furnishings and equipment, and landscaping.

8. Selective demolition.

9. Foundations, including footings, foundation walls.

10. Slabs-on-grade, including earthwork, subdrainage systems, and insulation.

11. Below-grade building construction, including excavation, backfill, and insulation and waterproofing/damp proofing.

12. Superstructure, including floor and roof construction and sprayed fire-resistive materials and board fire protection.

13. Exterior closure, including walls, parapets, doors, windows, and louvers.

14. Roofing, including roof insulation, coverings, flashings roof specialties roof accessories, and glazed openings.

15. Interior construction, including partitions, doors, interior glazed openings, and fittings.

16. Fire-protection specialties.

17. Stairs, including railings and finishes.

18. Interior finishes finish carpentry, architectural woodwork, interior specialties, and floor and ceiling finishes.

19. Miscellaneous items, including concrete equipment bases and painting of mechanical and electrical work.

20. Conveying systems, including elevators.

21. Equipment, including the following:

    a. Waste compactors.

    b. Food service equipment.

    c. Residential appliances.

22. Furnishings, including casework, window treatments, floor grilles and mats and murals. .

23. Special construction, including the following:

    a. Special-purpose rooms.

    b. Radiation protection.

B. Temporary facilities and controls in the General Construction Contract include, but are not limited to, the following:

1. Temporary facilities and controls that are not otherwise specifically assigned to the Plumbing Contract, HVAC Contract, Electrical Contract.

2. Sediment and erosion control.

3. Unpiped sewers and drainage, including drainage ditches, dry wells, stabilization ponds, and containers.

4. Stormwater control.

5. Temporary enclosure for building exterior, except as indicated.

6. Temporary roads and paved areas.

7. Dewatering facilities and drains.

8. Excavation support and protection, unless required solely for the Work of another contract.

9. Project identification and temporary signs.

10. General waste disposal facilities.

11. Pest control.

12. Temporary stairs.

13. Temporary fire-protection facilities.

14. Barricades, warning signs, and lights.

15. Site enclosure fence.

16. Covered walkways.

17. Security enclosure and lockup.

18. Environmental protection.

19. Maintenance and restoration of Owner's existing facilities used as temporary facilities.

1.6 PLUMBING CONTRACT

A. Work of the Plumbing Contract includes, but is not limited to, the following:

1. All work indicated in Drawings P0.0 through PD 1.0 not indicated to be performed by another prime contract.

2. All work indicated in the Division 01 and 22 specifications.

3. Site water supply and distribution.

4. Site sanitary sewerage.

5. Site storm drainage

6. Site fuel distribution.
7. Site special plumbing systems.
8. Plumbing fixtures.
9. Domestic water distribution.
10. Sanitary waste.
11. Stormwater drainage.
12. Special plumbing systems, including the following:
    a. Compressed air.
    b. Deionized water.
    c. Distilled water.
    d. Fuel oil.
    e. Natural gas.
    f. Vacuum.
    g. Acid waste.
13. Fire-suppression systems.

B. Temporary facilities and controls in the Plumbing Contract include, but are not limited to, the following:

1. Piped sewerage and drainage.
2. Piped gas service.
3. Piped water service.
4. Piped temporary toilet fixtures, wash facilities, and drinking water facilities.

1.7 MECHANICAL CONTRACT

A. Work of the HVAC Contract includes, but is not limited to, the following:

1. All work indicated in Drawings NM.0 through MD 1.0 not indicated to be performed by another prime contract.
2. All work indicated in the Division 01 and 23 specifications.
3. Site steam distribution.

4. Site hydronic distribution.

5. Energy supply, including oil, gas, steam, hot- and chilled-water supply systems.

6. HVAC systems and equipment.

7. HVAC instrumentation and controls.

8. HVAC testing, adjusting, and balancing.

9. Building automation system.

1.8 ELECTRICAL CONTRACT

A. Work of the Electrical Contract includes, but is not limited to, the following:

1. All work indicated in Drawings E0.0 through ED 1.0 not indicated to be performed by another prime contract.

2. All work indicated in the Division 01 and 26-27 specifications.

3. Site electrical distribution.

4. Site lighting.

5. Site communications and security.

6. Electrical service and distribution.

7. Exterior and interior lighting and light pole bases.

8. Communication and security.

9. Special electrical systems, including the following:

a. Uninterruptible power supply systems.

b. Packaged engine generator systems.

c. Battery power systems.

d. Cathodic protection.

e. Electromagnetic shielding systems.

f. Lightning protection systems.

g. Unit power conditioners.

h. Power generation systems.

B. Temporary facilities and controls in the Electrical Contract include, but are not limited to, the following:

1. Electric power service and distribution.

2. Lighting, including site lighting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted at any time from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.

2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: At the direction of the Owner, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF DEDUCT ALTERNATES

A. Alternate No. 1: Landscape on Walnut Street.

1. Extend the Landscape on Walnut Street between the retaining walls as shown and identified on the Landscape drawings.

B. Alternate No. 2: Landscape near Main Entry

1. Landscape the two planter areas adjacent to both sides of the Main Entry as shown and identified on the Landscape drawings.

C. Alternate No. 3: Landscape near Driveway

1. Landscape the area between driveway to parking lot behind and sidewalk as shown and identified on the Landscape drawings.

D. Alternate No. 4: New Park Benches

1. Remove the 4 existing park benches and replace them with new park benches as shown and identify on the Landscape drawings.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Submit executed Substitution Request Form for each proposed substitution.

2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.

b. Coordination information, including a list of changes or revisions 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. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

e. Samples, where applicable or requested.

f. Certificates and qualification data, where applicable or requested.

g. List of similar installations completed by the Contractor for completed projects with project names and addresses and names and addresses of architects and owners.

h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

i. Research reports evidencing compliance with applicable building codes.

j. 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 date of receipt of purchase order, lack of availability, or delays in delivery.

k. Cost information, including a proposal of change, if any, in the Contract Sum.

l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.

m. 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. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Engineer’s Supplemental Instructions for minor changes in the Work.

b. Use product specified if Engineer does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.

b. Requested substitution will not adversely affect Contractor's construction schedule.

c. Requested substitution has received necessary approvals of authorities having jurisdiction.

d. Requested substitution is compatible with other portions of the Work.

e. Requested substitution has been coordinated with other portions of the Work.

f. Requested substitution provides specified warranty.

g. 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.

B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

A. Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time**.**

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Engineer will 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. Work Change Proposal Requests issued by Engineer are not 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.

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.

B. Contractor-Initiated Work Change Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Engineer.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. 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.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. Include costs of labor and supervision directly attributable to the change.

5. 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.

6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.4 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.5 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Engineer may issue a Construction Change Directive on AIA Document G714. 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 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 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.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate 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. Submittal schedule.

c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Engineer at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use 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:

a. Project name and location.

b. Name of Engineer.

c. Engineer's project number.

d. Contractor's name and address.

e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.

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 of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

        1) Labor.

        2) Materials.

        3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

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 required, include evidence of insurance.

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.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Engineer 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: 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.

C. Payment Application Times: Submit Application for Payment to Engineer by the first of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

1. Submit draft copy of Application for Payment at least three days prior to the first of the month.

2. Projections on Applications for Payment are not permitted.

3. Provide three (3) hard copies of Application for Payment or one (1) electronic copy.

D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineers 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 are made.

2. Include amounts for work completed following previous Application for Payment, whether payment has been received. Include only amounts for work completed at time of Application for Payment.

3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.

2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.

3. Provide summary documentation for stored materials indicating the following:

a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.

b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.

c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

G. 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 (preliminary if not final).

5. Schedule of unit prices.

6. Submittal 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. Performance and payment bonds.

15. Data needed to acquire Owner's insurance.

H. Application for Payment at Substantial Completion: After Engineer issues 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 Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: After completing Project closeout requirements, 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.
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 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 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. RFIs.
3. Digital project management procedures.
4. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

1.2 DEFINITIONS

A. RFI: Request for Information. Request from Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.

1.4 GENERAL COORDINATION PROCEDURES

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 to ensure maximum performance and accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination of Multiple Contracts: Each contractor shall cooperate with Project coordinator, who shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with 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 performance and accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

C. 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.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities [and scheduled activities of other contractors and direction of Project coordinator] to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

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.

1.5 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return RFIs submitted to Engineer by other entities controlled by Contractor with no response.

2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.

2. Owner name.

3. Date.

4. Name of Contractor.

5. RFI number, numbered sequentially.

6. RFI subject.

7. Specification Section number and title and related paragraphs, as appropriate.

8. Drawing number and detail references, as appropriate.

9. Field dimensions and conditions, as appropriate.

10. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

11. Contractor's signature.

12. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Engineer.

1. Attachments shall be electronic files in PDF format.

D. Engineer’s Action: Engineer will review each RFI, determine action required, and respond. Allow seven days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated 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 Documents.

    d. Requests for adjustments in the Contract Time or the Contract Sum.

e. Requests for interpretation of Engineer's actions on submittals.

f. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

3. Engineer'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 according to Section 012600 "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 10 days of receipt of the RFI response.

4. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Engineer's Digital Data Files: Digital data files of Engineer's [BIM model] [CAD drawings] will be provided by Engineer for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.

2. Engineers make no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.

3. Contractor shall execute a data licensing agreement form provided by the Engineer upon the Contractor’s formal request for Data Files.

1.7 PROJECT MEETINGS

A. General: Engineer will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer.

C. Construction Progress Meetings: Engineer will conduct progress meetings at biweekly intervals.

D. Attendees: In addition to representatives of Owner, Utility Companies and Engineer, 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 meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

E. 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.

2) Review present and future needs of each entity present.

F. Minutes: Engineer will record and distribute the meeting minutes to each party present and to parties requiring information.

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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer responsive action.

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer responsive action. Submittals may be rejected for not complying with requirements.

1.3 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Engineer and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Engineer’s Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Engineer for Contractor's use in preparing submittals.

B. 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. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer’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. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.

2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.

3. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. Identification and Information: Place a permanent label or title block on each paper copy submittal item 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 Engineer.

3. Include the following information for processing and recording action taken:

a. Project name.

b. Date.

c. Name of Engineer.

d. Name of Contractor.

e. Name of subcontractor.

f. Name of supplier.

g. Name of manufacturer.

h. Submittal number or other unique identifier, including revision identifier.

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.

E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:

1. Name file with submittal number or other unique identifier, including revision identifier.

2. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.

3. Include the following information on an inserted cover sheet:

    a. Project name.

    b. Date.

    c. Name and address of Engineer.

    d. Name of Contractor.

    e. Name of firm or entity that prepared submittal.

    f. Name of subcontractor.

    g. Name of supplier.

    h. Name of manufacturer.

    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. Related physical samples submitted directly.

    m. Other necessary identification.

F. Options: Identify options requiring selection by the Engineer.

G. Deviations: Identify deviations from the Contract Documents on submittals.

H. Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Submit one electronic copy of submittal to concurrent reviewer in addition to specified number of copies to Engineer.

I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will discard submittals received from sources other than Contractor.

J. Resubmittals: Make resubmittals in the same form 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 with approval notation from Engineer's action stamp.

K. 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.

L. Use for Construction: Use only final submittals that are marked with approval notation from Engineer's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

1. Action Submittals: Submit one electronic copy.

2. Informational Submittals: Submit one electronic copy.

3. Signature: Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

4. Test and Inspection Reports Submittals: Comply with requirements specified.

5. Build America Buy America (BABA): BABA Compliance is required for all iron/steel, manufactured products, and construction materials be produced or manufactured in the United States.

a. Compliance Documentation must be provided for each product/material submitted.

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 published 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.

3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.

b. Manufacturer's product specifications.

c. Standard color charts.

d. Statement of compliance with specified referenced standards.

e. Testing by recognized testing agency.

f. Application of testing agency labels and seals.

g. Notation of coordination requirements.

h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams showing factory-installed wiring.

b. Printed performance curves.

c. Operational range diagrams.

d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.

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. Identification of products.

b. Schedules.

c. Compliance with specified standards.

d. Notation of coordination requirements.

e. Notation of dimensions established by field measurement.

f. Relationship and attachment to adjoining construction clearly indicated.

g. Seal and signature of professional engineer if specified.

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 30 by 42 inches.

3. Submit Shop Drawings in the following format:

a. One electronic copy of each submittal. Plans shall bear the Contractors stamp of approval.

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 applicable 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: 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 one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.

E. Product Schedule: 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. Submit product schedule in the following format:

a. One electronic copy of product schedule or list, unless otherwise indicated.

F. Contractor's Construction Schedule: Comply with requirements specified in Section 013100 "Project Management and Coordination."

G. Application for Payment: Comply with requirements specified in Section 012900 "Payment Procedures."

H. Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design.

1. Number of Copies: One electronic copy of subcontractor list, unless otherwise indicated.

2. All subcontractors are subject to approval by Owner

J. Coordination Drawings: Comply with requirements specified in Section 013100 "Project Management and Coordination."

K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.

L. Installer Certificates: Submit 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.

M. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

N. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

O. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

P. Material Test Reports: Submit 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.

Q. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

R. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

S. Schedule of Tests and Inspections: Comply with requirements specified.

T. Preconstruction Test Reports: Submit 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.

U. Compatibility Test Reports: Submit 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.

V. Field Test Reports: Submit reports 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.

W. Maintenance Data: Prepare and submit maintenance information.

X. Design Data: Prepare and submit 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.

2.2 DELEGATED-DESIGN SERVICES

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 Engineer.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: 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 Engineer.

B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Section 017700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER’S ACTION

A. General: Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

C. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

D. Incomplete 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.

END OF SECTION 013300

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Engineer, testing agencies, and authorities having jurisdiction.

1.3 QUALITY ASSURANCE

A. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

B. Accessible Temporary Egress: Comply with the requirements of Authorities having jurisdiction.

1.4 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to 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, 0.148-inch thick, 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 FACILITIES

A. Field Offices:

1. Contractor to provide an on-site space for their own use at their discretion upon acceptance by the Owner. Owner will provide a usable space for progress meetings.

B. Storage Units:

1. Provide storage units, furnished, and equipped to accommodate materials and equipment for construction operations. Store combustible materials apart from building.

C. Temporary Sanitary Facilities:

1. Provide temporary toilets, wash facilities, and drinking water for use of construction personnel.

a. Provide self-contained, single occupant toilet units of the chemical, aerated recirculation type. Provide units properly vented and fully enclosed in a glass-fiber-reinforced polyester sheet or similar nonabsorbent material.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

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.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

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.

C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.

3. Perform daily construction cleanup and final cleanup.

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. Water Service:

1. Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

C. Temporary Heating and Cooling: Provide 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.

D. Electric Power Service:

1. Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

a. Connect temporary service to Owner's existing power source, as directed by Owner.

E. Lighting: Provide 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.

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: Use designated areas of Owner's existing parking areas for construction personnel.

C. Storage and Staging: Use designated areas of Project site for storage and staging needs.

D. 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 or endanger permanent Work or temporary facilities.

2. Remove snow and ice as required to minimize accumulations.

E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.

2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

3. Maintain and touch up signs, so they are legible at all times.

F. Waste Disposal Facilities:

1. Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

G. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

1. Do not load elevators beyond their rated weight capacity.

2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work, so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

H. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Temporary Erosion and Sedimentation Control:

1. Comply with requirements of EPA Construction General Permit, authorities having jurisdiction, and requirements specified in Section 311000 "Site Clearing."

C. Stormwater Control: Comply with requirements of 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:

1. 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 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 .

F. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

G. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

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. 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.

END OF SECTION 015000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Installation of the Work.
3. Cutting and patching.
4. Progress cleaning.
5. Protection of installed construction.
6. Correction of the Work.

1.2 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or 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 for patching 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 provide a match acceptable to the Engineer for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: Contractor shall be responsible for the verification of all existing conditions prior to the start of construction.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, 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 walls, floors, ceilings and framing for suitable conditions where products and systems are to be installed.

3. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. 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.

B. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Engineer according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings. If discrepancies are discovered, notify Engineer promptly.

B. General:

1. Establish benchmarks and control points to set lines and levels wheres needed to locate each element of Project.

2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3. Inform installers of lines and levels to which they must comply.

4. Check the location, level and plumb, of every major element as the Work progresses.

5. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.

6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

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.

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 demolition 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. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.

2. Allow for movement in existing construction, 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.

G. 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.

H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 CUTTING AND PATCHING

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

C. Temporary Support: Provide temporary support of Work to be cut.

D. 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.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

F. 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 prevent interruption to occupied areas.

G. 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.

H. 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 practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical 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.

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, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. 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 and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. 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 waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).

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: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers, roof drains or into waterways.

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 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

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.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Correction of the work.

1.2 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with 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. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
7. Complete final cleaning requirements, including touchup painting.
8. 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, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer 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 Engineer, 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.

1.3 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."

2. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. 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. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer 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.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization 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.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

2. Submit list of incomplete items.

1.5 WARRANTIES

A. Submittal Time: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Scan warranties and bonds and assemble a complete warranty and bond submittal package into a single, indexed electronic PDF file. The PDF shall include hyperlinks to enable navigation to each item, as well as a table of contents at the beginning of the document.

2. Save the electronic PDF file to a USB flash drive labeled with the Project name and Contractor name. Submit a minimum of two (2) USB drive as the official warranty and bond documentation.

3. Do not submit hard copy binders unless specifically requested by the Owner.

4. If multiple volumes are required due to file size, create separate indexed PDFs and clearly label each file (e.g., “Warranties_Part1”, “Warranties_Part2”, etc.) on the USB drive.

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: Perform 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 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. Clean exposed exterior hard-surfaced finishes to a pre-construction condition.

f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

g. 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 other required labels and identification, including mechanical and electrical nameplates.

h. Leave Project clean.

3.2 CORRECTION OF THE WORK

A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

BARRY ISETT & associates INC

MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 02

Existing Conditions

SECTION 024119 – SELECTIVE DEMOLITION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. Work Included (Base Bid):

1. See plans for extent of first floor demolition work.

1.3 CODES

A. Demolition construction shall be in strict compliance with all State and Local Codes governing this procedure, including the proper handling and disposal or demolished materials.

1.4 DUST CONTROL

A. Dust created by the demolition of walls, ceiling, etc., must be contained within the areas being reconstructed and any dust being exhausted naturally or mechanically to the exterior environment must be controlled and kept from entering other areas of the building or from being deposited on neighboring ground.

B. Debris being disposed of through chutes to exterior containers must be dampened occasionally to prevent excessive air borne dust into the environment.

PART 2 – PRODUCTS

2.1 PLASTIC

A. 6 mil polyethylene film.

PART 3 – EXECUTION

3.1 DEMOLITION

A. Thoroughly investigate existing structure, utilities, finishes, etc., involved in the demolition work scheduled prior to starting of work. Any questions should be brought to the attention of the Architect prior to engaging in the demolition work.

B. Area must be thoroughly sealed off from other interior spaces with dust screens and noise should be kept to a minimum. If debris is to be removed through interior corridors, plastic and other barriers shall be laid down and constructed to protect existing finishes from damage.

C. All debris shall be removed from site on a daily basis and premises including work area and interior adjoining spaces and corridor shall be kept clean and free from loose debris.

3.2 SAFETY

A. Extreme care shall be taken to properly barricade and identify any construction area. Pedestrian traffic through corridors adjacent to construction areas should be limited during periods of moving debris through corridor. Coordinate the safety and proper notification of employees concerning construction in their areas.

3.3 UTILITIES

A. Investigate and coordinate the removal and modification of any existing utilities with the Owner and keep any shut-off of utilities to facility to a minimum.

3.4 SALVAGE

A. The Owner will reserve the right to maintain ownership of any of the fixtures, finishes and materials scheduled to be demolished. Any materials to be salvaged for the Owner will be determined and be made known prior to the start of the demolition work. Materials shall be disconnected, removed and set aside for removal or storage by the Owner.

END OF SECTION 024119

BARRY ISETT & associates INC

MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 03

Concrete

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

2. Freestanding exterior stairs.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for decorative concrete pavement and walks.

1.2 DEFINITIONS

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

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.

b. Concrete Subcontractor.

2. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.

b. Construction joints, control joints, isolation joints, and joint-filler strips.

c. Semirigid joint fillers.

d. Vapor-retarder installation.

e. Anchor rod and anchorage device installation tolerances.

f. Cold and hot weather concreting procedures.

g. Concrete finishes and finishing.

h. Curing procedures.

i. Forms and form-removal limitations.

j. Shoring and reshoring procedures.

k. Methods for achieving specified floor and slab flatness and levelness.

l. Concrete repair procedures.

m. Concrete protection.

n. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)

o. Protection of field cured field test cylinders.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.

2. Fly ash.

3. Slag cement.

4. Blended hydraulic cement.

5. Silica fume.

6. Performance-based hydraulic cement

7. Aggregates.

8. Admixtures:

a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

9. Joint fillers.

10. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.

2. Minimum 28-day compressive strength.

3. Durability exposure class.

4. Maximum w/cm.

5. Calculated equilibrium unit weight, for lightweight concrete.

6. Slump limit.

7. Air content.

8. Nominal maximum aggregate size.

9. Steel-fiber reinforcement content.

10. Synthetic micro-fiber content.

11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.

12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.

13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.

14. Intended placement method.

15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

    a. Location of construction joints is subject to approval of the Architect

2. Steel Reinforcement Shop Drawings: Comply with ACI SP-066

    a. Include placing drawings that detail fabrication, bending, and placement.

    b. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

    c. Reproducing the Contract Drawings for submission as Shop Drawings will not be permitted.

D. Samples: For manufacturer's standard colors for color pigment.

E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Bonding agents.
5. Adhesives.
6. Vapor retarders.
7. Joint-filler strips.
8. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Silica fume.
5. Aggregates.

6. Admixtures:

   a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

D. Research Reports:

E. Field quality-control reports.

F. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

2. Personnel conducting field tests to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

D. Mockups: Cast concrete formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Formed Surfaces: Build panel approximately 100 sq. ft. (9.3 sq. m) in the location indicated or, if not indicated, as directed by Architect.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. ACI Publications: Comply with ACI 301 unless otherwise indicated.

F. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

    a. Concrete mixture design.

    b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

    a. Contractor's superintendent.

    b. Independent testing agency responsible for concrete design mixtures.

    c. Ready-mix concrete manufacturer.

    d. Concrete paving subcontractor.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

    a. Admixture dosage rates.

    b. Slump.

    c. Air content.

    d. Seven-day compressive strength.

    e. 28-day compressive strength.

    f. Permeability.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

2. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).

3. Do not use frozen materials or materials containing ice or snow.

4. Do not place concrete in contact with surfaces less than 35 deg F (1.7 deg C), other than reinforcing steel.

5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M), and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F (35 deg C).

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.

B. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

C. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

D. Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

2.4 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.

2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.

3. Obtain aggregate from single source.

4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II, white.

2. Fly Ash: ASTM C618, Class C or F.

3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C330/330M

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.

E. Air-Entraining Admixture: ASTM C260/C260M.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete.

Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

1. Retarding Admixture: ASTM C494/C494M, Type B.

2. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.

3. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

4. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.

5. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

6. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.

2.5 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

a. Ambient Temperature Below 50 deg F (10 deg C): Black.

b. Ambient Temperature between 50 deg F (10 deg C) and 85 deg F (29 deg C): Any color.

c. Ambient Temperature Above 85 deg F (29 deg C): White.

D. Water: Potable or complying with ASTM C1602/C1602M.

E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

F. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.6 VAPOR RETARDER

A. Sheet Vapor Retarder, Class C: ASTM E1745, Class C, not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301 (ACI 301M).

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.

2. Slag Cement: 50 percent by mass.

3. Silica Fume: 10 percent by mass.

4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

D. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.9 CONCRETE MIXTURES

A. Slabs-on-Grade (Interior): Normal-weight concrete.

a. 4,000 psi min. at 28-day compressive strength.

b. Type I or II cement.

c. Air Content: N/A

d. Max W/C = 0.55

e. Slump: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding HRWR admixture.

B. Slabs-on-Grade (Exterior): Normal-weight concrete.

a. 5,000 psi min. at 28-day compressive strength.

b. Type I or II cement.

c. Air Content: 6%

d. Max W/C = 0.40

e. Slump: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding HRWR admixture.

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.

1. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.

2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.

4. Security and protection for test samples and for testing and inspection equipment at Project site. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

5. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

3.4 FORMWORK

A. Forms: Forms shall be constructed of approved material. Material shall be chosen based on strength and concrete finish requirements.

B. Design: Formwork shall be designed for loads and lateral pressures outlined in Chapter 1, Recommended practice for Concrete Formwork (ACI 347). Formwork design and construction are the responsibility of the Contractor.

3.5 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.6 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.

2. Face laps away from exposed direction of concrete pour.

3. Lap vapor retarder over footings and grade beams not less than 6 inches (150 mm), sealing vapor retarder to concrete.

4. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.

6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.

7. Protect vapor retarder during placement of reinforcement and concrete.

    a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches (150 mm) on all sides, and sealing to vapor retarder.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.

2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

C. Concrete Steps.

1. Apply a smooth tooled finish to non-traffic portions of the steps, including nosings, risers and sides.

2. Apply the specified broom finish perpendicular to the line of travel on the stair treads and landings.

3. Ensure that any reinforcing steel is set on chairs and firmly wired in place.

3.8 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.

2. Place joints perpendicular to main reinforcement.

a. Continue reinforcement across construction joints unless otherwise indicated.

b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Space vertical joints in walls. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.

4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.

2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface, where joint sealants, are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.

2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.

2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.

2. Deposit concrete to avoid segregation.

3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.

4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).

a. Do not use vibrators to transport concrete inside forms.

b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.

c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.

d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete slabs in a checkerboard sequence.

2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3. Maintain reinforcement in position on chairs during concrete placement.

4. Screed slab surfaces with a straightedge and strike off to correct elevations.

5. Level concrete, cut high areas, and fill low areas.

6. Slope surfaces uniformly to drains where required.

7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.

8. Do not further disturb slab surfaces before starting finishing operations.

3.10 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

   a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.

   b. Remove projections larger than 1 inch (25 mm).

   c. Tie holes do not require patching.

   d. Surface Tolerance: ACI 117 (ACI 117M) Class D.

   e. Apply to concrete surfaces not exposed to public view.

2. ACI 301 (ACI 301M) Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

   a. Patch voids larger than 1/4 inch (6 mm) wide or 1/2 inch (13 mm) deep.

   b. Remove projections larger than 1/4 inch (6 mm).

   c. Patch tie holes.

   d. Surface Tolerance: ACI 117 (ACI 117M) Class B.

   e. Locations: Apply to concrete surfaces exposed to public view,.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:

   a. Perform no later than one day after form removal.

b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.

c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.

d. Maintain required patterns or variances as shown on Drawings or to match mockups.

3.11 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.

2. Mix, place, and cure concrete, as specified, to blend with in-place construction.

3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases as indicated on the Drawings, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.

3. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.

3.12 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.

2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.

3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.

2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.

3. If forms remain during curing period, moist cure after loosening forms.

4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.

    b. Continuous Sprinkling: Maintain concrete surface continuously wet.

    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.

    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.

    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.

        2) Maintain continuity of coating and repair damage during curing period.

3.13 TOLERANCES

A. Conform to ACI 117 (ACI 117M).

3.14 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

A. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete.

    a. Limit cut depth to 3/4 inch (19 mm).

    b. Make edges of cuts perpendicular to concrete surface.

    c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.

    d. Fill and compact with patching mortar before bonding agent has dried.

    e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

    a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.

    b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.

2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.

3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

    a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

        1) Project name.

        2) Name of testing agency.

3) Names and certification numbers of field and laboratory technicians performing inspections and testing.

4) Name of concrete manufacturer.

5) Date and time of inspection, sampling, and field testing.

6) Date and time of concrete placement.

7) Location in Work of concrete represented by samples.

8) Date and time sample was obtained.

9) Truck and batch ticket numbers.

10) Design compressive strength at 28 days.

11) Concrete mixture designation, proportions, and materials.

12) Field test results.

13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.

14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

1. Compressive-Strength Tests: ASTM C39/C39M.

a. Test one set of three laboratory-cured specimens at seven days and one set of two specimens at 28 days.

b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

2. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

3. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa) if specified compressive strength is 5000 psi (34.5 MPa), or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi (34.5 MPa).

4. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

5. Additional Tests:

   a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

   b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

      1) Acceptance criteria for concrete strength to be in accordance with ACI 301 (ACI 301M), Section 1.6.6.3.

6. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

7. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.17 PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

E. Protect concrete surfaces until all adjacent installations are complete.

END OF SECTION 033000

BARRY ISETT & associates INC

MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 05

Metals

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum railings.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of mechanically connected railings.
2. Handrail brackets.
3. Nonshrink, nonmetallic grout.
4. Anchoring cement.

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

C. Samples: For each type of exposed finish.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.

b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.

c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).

b. Infill load and other loads need not be assumed to act concurrently.

2.2 METALS, GENERAL

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

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.3 ALUMINUM RAILINGS

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Tubing]: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.

C. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.

D. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

E. Die and Hand Forgings: ASTM B247 (ASTM B247M), Alloy 6061-T6.

F. Castings: ASTM B26/B26M, Alloy A356.0-T6.

2.4 FASTENERS

A. Fastener Materials:

1. Aluminum Railing Components: Type 304 stainless steel fasteners.

B. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

2.5 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Cast aluminum, center of handrail 2-1/2 inches (63.5 mm) face of railing.

B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.

1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

1. Water-Resistant Product: At exterior locations and where indicated on Drawings, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.

2. Remove sharp or rough areas on exposed surfaces.

B. Form work true to line and level with accurate angles and surfaces.

C. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

D. Form changes in direction as follows:

1. As detailed.

E. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

H. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.

1. Fabricate anchorage devices capable of withstanding loads imposed by railings.

2. Coordinate anchorage devices with supporting structure.

2.7 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44.

1. Color: As selected by Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.

2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.

3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.

4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 ANCHORING POSTS

A. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Install railing gates level, plumb, and secure for full opening without interference.

C. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.3 CLEANING

A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055213

BARRY ISETT & associates INC
MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 06

Wood, Plastics & Composites

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rooftop equipment bases and support curbs.

2. Wood blocking, cants, and nailers.

1.3 ACTION 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. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

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.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.

2. Fire-retardant-treated wood.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

3. Provide dressed lumber, S4S, unless otherwise indicated.

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

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all miscellaneous carpentry unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.

2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

E. Application: Treat all miscellaneous carpentry unless otherwise indicated.

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. Rooftop equipment bases and support curbs.

4. Cants.

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

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Metal Framing: ASTM C 954, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.6 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

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. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

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.

F. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

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.

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

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 PROTECTION

A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

BARRY ISETT & associates INC
MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 07

Thermal and Moisture Protection

SECTION 072100 - THERMAL 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. Extruded polystyrene foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Mineral-wool blanket insulation.
4. Loose-fill insulation.
5. Spray-Foam

B. Related Requirements:

1. Section 04 20 00 "Unit Masonry" for insulation installed in masonry cells.
2. Section 06 16 00 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
3. Section 07 14 16 "Cold Fluid-Applied Waterproofing" for insulated drainage panels installed with plaza deck insulation.
4. Section 07 54 23 "Thermoplastic-Polyolefin (TPO) Roofing"
5. Section 09 29 00 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Extruded polystyrene foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Mineral-wool blanket insulation.
4. Loose-fill insulation.
5. Spray Foam

1.4 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

1. For blown-in or sprayed fiberglass and cellulosic-fiber loose-fill insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.

2. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.

3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded Polystyrene Board Insulation, Type X : ASTM C578, Type X, 15-psi (104-kPa) minimum compressive strength; unfaced.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DiversiFoam Products.

b. DuPont de Nemours, Inc.

c. Owens Corning.

d. The Dow Chemical Company.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.

3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.

4. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

B. Extruded Polystyrene Board Insulation, Type IV : ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DiversiFoam Products.

b. DuPont de Nemours, Inc.

c. Kingspan Insulation LLC.

d. Owens Corning.

e. The Dow Chemical Company.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.

3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.

4. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

C. Extruded Polystyrene Board Insulation, Type IV, Drainage Panels : ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DiversiFoam Products.

b. DuPont de Nemours, Inc.

c. Owens Corning.

d. The Dow Chemical Company.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.

3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.

4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.2 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced : ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed; SAINT-GOBAIN.

b. Johns Manville; a Berkshire Hathaway company.

c. Knauf Insulation.

d. Owens Corning.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.

3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.

4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

B. Glass-Fiber Blanket Insulation, Kraft Faced : ASTM C665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed; SAINT-GOBAIN.

b. Johns Manville; a Berkshire Hathaway company.

c. Knauf Insulation.

d. Owens Corning.

2. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

C. Glass-Fiber Blanket Insulation, Reinforced-Foil Faced : ASTM C665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed; SAINT-GOBAIN.

b. Johns Manville; a Berkshire Hathaway company.

c. Knauf Insulation.

d. Owens Corning.

2. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

D. Glass-Fiber Blanket Insulation, Foil Faced : ASTM C665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed; SAINT-GOBAIN.

b. Johns Manville; a Berkshire Hathaway company.

c. Knauf Insulation.

d. Owens Corning.

2. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.3 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Unfaced : ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Owens Corning.

c. ROCKWOOL.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.

3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.

4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

B. Mineral-Wool Blanket Insulation, Reinforced-Foil Faced : ASTM C665, Type III (reflective faced); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Owens Corning.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.

3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.

4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.4 LOOSE-FILL INSULATION

A. Cellulosic-Fiber Loose-Fill Insulation : ASTM C739, chemically treated for flame-resistance, processing, and handling characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Greenfiber, LLC.

    b. Hamilton Manufacturing, Inc. (HMI).

    c. Nu-Wool Co., Inc.

2.5 OPEN-CELL SPRAY POLYURETHANE FOAM INSULATION

A. Open-Cell Spray Polyurethane Foam: Spray-applied polyurethane foam using water as a blowing agent. Minimum density of 0.4 lb/cu. ft. (6.4 kg/cu. m) and minimum aged R-value at 1-inch (25.4-mm) thickness of 3.4 deg F x h x sq. ft./Btu at 75 deg F (24 K x sq. m/W at 24 deg C).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carlisle Spray Foam Insulation.

    b. Gaco; a brand of Firestone Building Products.

    c. Henry Company.

    d. Johns Manville; a Berkshire Hathaway company.

    e. Master Builders Solutions.

2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 75 or less.

b. Smoke-Developed Index: 450 or less.

3. Fire Propagation Characteristics: Passes NFPA 285 and NFPA 276 testing as part of an approved assembly.

2.6 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGM Industries, Inc.

b. Gemco.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.

3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGM Industries, Inc.

b. Gemco.

2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:

a. Crawl spaces.

b. Ceiling plenums.

c. Attic spaces.

C. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 2 inches (50 mm) between face of insulation and substrate to which anchor is attached.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Gemco.

D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGM Industries, Inc.

b. Gemco.

2.7 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

C. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions.
2. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.

3. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.

4. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.

5. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer.

1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.

2. Press units firmly against inside substrates.

3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 20 00 "Unit Masonry."

B. Cellular-Glass Board Insulation: Install with closely fitting joints using attachment method according to manufacturer's written instructions.

C. Mineral-Wool Board Insulation: Install insulation fasteners 4 inches (100 mm) from each corner of board insulation, at center of board, and as recommended by manufacturer.

1. Fit courses of insulation between masonry wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.

2. Press units firmly against inside substrates.

3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.

5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

6. For wood-framed construction, install blankets according to ASTM C1320 and as follows:

a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

a. Exterior Walls: Set units with facing placed toward as indicated on Drawings.

b. Interior Walls: Set units with facing placed toward areas of high humidity .

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

C. Loose-Fill Insulation: Apply according to ASTM C1015 and manufacturer's written instructions.

1. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.

2. For cellulosic-fiber loose-fill insulation, comply with CIMA's Bulletin #2, "Standard Practice for Installing Cellulose Insulation."

3.7 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass.

2. Maintain cavity width of dimension indicated on Drawings between insulation and glass.

3. Install insulation to fit snugly without bowing.

3.8 INSTALLATION OF REFLECTIVE INSULATION

A. Install sheet reflective insulation according to ASTM C727.

B. Install sheet radiant barriers according to ASTM C1744.

C. Install interior radiation control coating system according to ASTM C1321.

3.9 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

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 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. Section Includes:

1. Silicone joint sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples: For each kind and color of joint sealant required.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Preconstruction compatibility and adhesion test reports.

C. Preconstruction field-adhesion test reports.

D. Field-adhesion test reports.

E. Warranties.

1.5 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.

2. Sealant Primers for Nonporous Substrates: 250 g/L.

3. Sealant Primers for Porous Substrates: 775 g/L.

B. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.2 SILICONE JOINT SEALANTS

A. Mildew-Resistant Silicone Joint Sealant: ASTM C 920.

1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

a. BASF Building Systems.

b. Dow Corning Corporation.

c. Pecora Corporation.

d. Sika Corporation; Construction Products Division.

e. Tremco Incorporated.

2. Type: Single component (S)

3. Grade: non-sag (NS).

4. Uses Related to Exposure: Nontraffic (NT).

2.3 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.4 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.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

1. Remove laitance and form-release agents from concrete.

2. Clean nonporous joint substrate 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 by joint-sealant manufacturer or as indicated by 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 or primer 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.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Install sealant backings of kind 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.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. 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.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs 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 profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

F. 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.

END OF SECTION 079200

BARRY ISETT & associates INC

MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 08

Openings

SECTION 081113 - HOLLOW METAL 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.

2. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".

2. Division 08 Section “Flush Wood Doors”.

3. Division 08 Section "Door Hardware".

4. Division 09 Sections "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.

3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.

4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.

5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.

6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.

10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.

11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.

12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.

13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.

14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.

15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.

2. Details of doors, including vertical and horizontal edge details and metal thicknesses.

3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.

5. Details of anchorages, joints, field splices, and connections.

6. Details of accessories.

7. Details of moldings, removable stops, and glazing.

8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.

2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

3. Smoke Control Door Assemblies: Comply with NFPA 105.

a. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

1.5 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 non-vented plastic.

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. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

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

1.7 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.

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C). (Basis of Design)

2. Curries Company (CU).

3. Pioneer Industries (PI).

4. Steelcraft (S).

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch 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 and ANSI/NAAMM HMMA 867.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.

2. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.

3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.

4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.

5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.

   a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

2. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.

3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.

4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.

5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:

1. CECO Door Products (C) Honeycomb Core - Regent Series.

2.4 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.

2. Manufacturers Basis of Design:

a. CECO Door Products (C) – SU SR Series.

b. Curries Company (CU) – M Series.

C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.

2. Manufacturers Basis of Design:

a. CECO Door Products (C) - SU Series.

b. Curries Company (CU) - M Series.

D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.

3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.7 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

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. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.

2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.

3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: 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.

2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

   a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. 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.

4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.

5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.

7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.

8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

9. Jamb Anchors: Provide number and spacing of anchors as follows:

   a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

      1) Two anchors per jamb up to 60 inches high.

      2) Three anchors per jamb from 60 to 90 inches high.

      3) Four anchors per jamb from 90 to 120 inches high.

4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Three anchors per jamb up to 60 inches high.

2) Four anchors per jamb from 60 to 90 inches high.

3) Five anchors per jamb from 90 to 96 inches high.

4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.

2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.

3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.9 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

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; and compatible with substrate and field-applied coatings.

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. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. 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 square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, 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 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.

3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.

4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

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.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

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 and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

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. Section Includes:

1. Solid core doors with wood veneer faces.
2. Factory finishing wood doors.
3. Factory fitting wood doors to frames and factory machining for hardware.
4. Light frames and glazing installed in wood doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 08 Section “Door Schedule”.
3. Division 08 Section "Hollow Metal Doors and Frames".
4. Division 08 Section "Door Hardware".

C. Standards and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ANSI A208.1 – Wood Particleboard.
3. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
4. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
5. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
6. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

7. Window and Door Manufacturers Association - WDMA I.S.1-A Architectural Wood Flush Doors.

1.3 SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.1-A classifications. Include factory finishing specifications.

B. Shop Drawings shall include:

1. Indicate location, size, and hand of each door.

2. Indicate dimensions and locations of mortises and holes for hardware.

3. Indicate dimensions and locations of cutouts.

4. Indicate requirements for veneer matching.

5. Indicate location and extent of hardware blocking.

6. Indicate construction details not covered in Product Data.

7. Indicate doors to be factory finished and finish requirements.

8. Indicate fire protection ratings for fire rated doors.

C. Samples for Initial Selection: For factory finished doors.

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, 8 by 10 inches, with door faces and edges representing actual materials to be used.

a. Provide samples for each species of veneer and core material.

b. Finish veneer faced door samples with same materials proposed for factory finished doors.

3. Frames for light openings, 6 inches long, for each material, type, and finish required.

D. Warranty: Provide sample of manufacturer’s warranty.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors'.

C. Fire Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL10C.

1. Oversize Fire Rated Door Assemblies: For units exceeding sizes of tested assemblies provide manufacturer's construction label, indicating compliance to independent 3rd party certification agency's procedure, except for size.

2. Temperature Rise Limit: Where required and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire test exposure.

3. Smoke Control Door Assemblies: Comply with NFPA 105.

1) Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for receiving, handling, and installing flush wood doors.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package pre-finished doors individually in plastic bags and wrap bundles of doors in plastic sheeting.

C. Mark each door on top rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.

b. Telegraphing of core construction in wood face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

3. Warranty Period for Solid Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 DOOR CONSTRUCTION – GENERAL

A. WDMA I.S.1-A Performance Grade: Extra Heavy Duty; Aesthetic Grade: Premium.

B. Fire Rated Doors: Provide construction and core as needed to provide fire ratings indicated.

1. Category A Edge Construction: Provide fire rated door edge construction with intumescent seals concealed by outer stile (Category A) at 45, 60, and 90 minute rated doors. Comply with specified requirements for exposed edges.

2. Pairs: Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

a. Provide fire retardant stiles that are listed and labeled for applications indicated without formed steel edges and astragals.

b. Where required for concealed hardware, provide formed steel edges and astragals with intumescent seals. Finish steel edges and astragals with baked enamel.

2.2 CORE CONSTRUCTION

A. Particleboard Core Doors:

1. Particleboard: Wood fiber based materials complying with ANSI A208.1 Particleboard standard. Grade LD-2.

2. Adhesive: Fully bonded construction using Polyurethane (PUR) glue.

3. Blocking: As indicated under article “Blocking”.

2.3 BLOCKING

A. Fire Rated Doors:

1. Provide blocking as indicated below:

a. HB1: 5 inch in doors indicated to have closers and overhead stops.

2.4 VENEERED DOORS FOR TRANSPARENT FINISH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Graham: GPD Series.

2. Mohawk: Cendura Series.

3. VT Industries: Heritage doors.

B. Interior Solid Core Doors:

1. Grade: Premium.

2. Faces: Veneer grades as noted below; veneer minimum 1/50-inch (0.5mm) thickness at moisture content of 12% or less.

a. Manufacturer Standard Face: as selected by architect/owner.

b. Manufacturer Custom Face: as selected by architect/owner.

c. Match Existing.

d. Plain Sliced Select White Maple, A grade faces.

3. Match between Veneer Leaves: Book match.

4. Assembly of Veneer Leaves on Door Faces:

a. Running Match.

5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

6. Transom Match: Continuous match.

7. Vertical Edges: Matching same species as faces. Wood or composite material, one piece, laminated, or veneered. Minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors.

8. Horizontal Edges: Solid wood or structural composite material meeting the minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors

9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit sanded before applying face veneers.

10. At doors over 40% of the face cut-out for lights and or louvers, furnish engineered composite lumber core.

2.5 LIGHT FRAMES AND GLAZING

A. Wood Beads for Light Openings in Wood Doors up to and including 20-minute rating:

1. Wood Species: Same species as door faces.

2. Profile:

a. M1 Flush Bead.

b. At wood core doors with 20-minute fire protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Metal Frames for Light Openings in Fire Rated Doors over 20-minute Rating: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated.

1. Manufacturers:

a. Air Louver (LV).

b. All Metal Stamping (AP).

c. Anemostat (AN).

d. Pemko (PE).

C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with the flush wood door manufacturer's written instructions.

2.6 FABRICATION

A. Factory fit doors to suit frame opening sizes indicated.

1. Comply with requirements in NFPA 80 for fire rated doors.

2. Undercut: As required per manufacturer’s templates and sill condition.

B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

2. Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.

C. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.

2. Glazing: Comply with applicable requirements in Division 08 Section "Glazing."

3. Louvers: Factory install louvers in prepared openings.

D. Electrical Raceways: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 08 "Door Hardware". Wire nut connections are not acceptable.

2.7 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Transparent Finish: Provide a clear protective coating over the wood veneer allowing the natural color and grain of the selected wood species to provide the appearance specified. Stain is applied to the wood surface underneath the transparent finish to add color and design flexibility.

1. Finish: Meet or exceed WDMA I.S. 1A TR8 UV Cured Acrylated Polyester finish performance requirements.

2. Staining:

a. Stain color as selected by owner.

3. Sheen: Satin.

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. Installation Instructions: Install doors and frames to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.

C. Factory Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

E. Field modifications to doors shall not be permitted, except those specifically allowed by manufacturer or fire rating requirements.

3.3 ADJUSTING

A. Operation: Re-hang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION 081416

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 commercial door hardware for the following:

1. Swinging doors.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

2. ICC/IBC - International Building Code.

3. NFPA 80 - Fire Doors and Windows.

4. NFPA 101 - Life Safety Code.

5. NFPA 105 - Installation of Smoke Door Assemblies.

6. State Building Codes, Local Amendments.

D. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.

2. UL10C - Positive Pressure Fire Tests of Door Assemblies.

3. UL 305 - Panic Hardware.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.

b. Manufacturer of each item.

c. Fastenings and other pertinent information.

d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.

e. Explanation of abbreviations, symbols, and codes contained in schedule.

f. Mounting locations for door hardware.

g. Door and frame sizes and materials.

h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the 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 Schedule.

C. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary Integrated Wiegand Access Control Products.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.

2. Plans for existing and future key system expansion.

3. Requirements for key control storage and software.

4. Installation of permanent keys, cylinder cores and software.

5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.

3. Review sequence of operation narratives for each unique access controlled opening.

4. Review and finalize construction schedule and verify availability of materials.

5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.

2. Faulty operation of the hardware.

3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.

2. Five years for exit hardware.

3. Ten years for manual overhead door closer bodies.

4. Twenty five years for manual overhead door closer bodies.

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.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

1. Permanent cylinders, cores, and keys to be installed by Owner.

D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.

b. Three Hinges: For doors with heights 61 to 90 inches.

c. Four Hinges: For doors with heights 91 to 120 inches.

d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.

b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Options: Comply with the following:

a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

4. Manufacturers:

a. Hager Companies (HA).

b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).

c. Stanley Hardware (ST).

2.3 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.

2. Furnish dust proof strikes for bottom bolts.

3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.

4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

a. Door Controls International (DC).

b. Rockwood (RO).

c. Trimco (TC).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.

2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.

3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.

4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Manufacturers:

a. Hiawatha, Inc. (HI).

b. Rockwood (RO).

c. Trimco (TC).

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

1. Manufacturers:

a. Corbin Russwin (CR).

b. Sargent Manufacturing (SA).

C. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.

2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.

3. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

4. Keyway: Match Facility Standard.

D. Removable Cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.

E. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.

2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.

3. Existing System: Field verify and key cylinders to match Owner's existing system.

F. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)

2. Master Keys (per Master Key Level/Group): Five (5).

3. Construction Keys (where required): Ten (10).

4. Construction Control Keys (where required): Two (2).

G. Construction Keying: Provide temporary keyed construction cores.

H. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.

2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Where specified, provide status indicators with highly reflective color and wording for “locked/unlocked” or “vacant/occupied” with custom wording options if required. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status. Indicator window size to be a minimum of 2.1” x 0.6” with a curved design allowing a 180 degree viewing angle with protective covering to prevent tampering.

2. Manufacturers:

a. Corbin Russwin (CR)

b. Sargent Manufacturing (SA)

c. Schlage (SL) – Basis of design

2.6 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.

3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.

2. Dustproof Strikes: BHMA A156.16.

2.7 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.

    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.

8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

9. Rail Sizing: Provide exit device rails factory sized for proper door width application.

10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

    a. Corbin Russwin (CR)

    b. Sargent Manufacturing (SA)

2.8 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Manufacturers:

a. Norton Rixson (NO)

b. Sargent Manufacturing (SA)

C. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, high efficiency door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.

1. Manufacturers:

a. Norton Rixson (NO)

b. Sargent Manufacturing (SA)

2.9 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:

a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

6. Manufacturers:

a. Hager Companies (HA).

b. Rockwood (RO).

c. Trimco (TC).

2.10 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Hager Companies (HA).

b. Rockwood (RO).

c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. Norton Rixson (NO).

2.11 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).

2. Pemko (PE).

3. Reese Enterprises, Inc. (RE).

2.12 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.13 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. 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

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, 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. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically 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. DHI TDH-007-20: Installation Guide for Doors and Hardware.

3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."

4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and 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 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 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.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer’s Abbreviations:

1. MK - McKinney

2. MR - Markar

3. PE - Pemko

4. SU - Securitron

5. RO - Rockwood

6. SA – SARGENT

7. SL - Schlage

8. RF - Rixson

9. NO - Norton

10. OT - Other

Hardware Sets

See plans for detailed hardware schedule

END OF SECTION 087100

BARRY ISETT & associates INC

MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 09

Finishes

SECTION 092216 - NON STRUCTURAL METAL FRAMING

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. Non-load-bearing steel framing systems for interior partitions.

2. Suspension systems for interior ceilings and soffits.

3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:

1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Notify manufacturer of damaged materials received prior to installation.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated

2. Protective Coating: Comply with ASTM C645 ; ASTM A653/A653M, G40 (Z120); or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.

a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.

B. Studs and Track: .

1. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).

2. Depth: As indicated on Drawings .

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Track System: ASTM C645 top track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.

2. Double-Track System: ASTM C645 top outer tracks, inside track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.

3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Steel Network, Inc. (The).

D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fire Trak Corp.

b. Metal-Lite.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Steel Thickness: 0.0269 inch (0.683 mm).

F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 1-1/2 inches unless noted otherwise .

2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C645.

1. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm) .

2. Depth: 1-1/2 inches (38 mm).

H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 3/4 inch (19 mm) .

2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).

3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-steel thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

a. Uses: Securing hangers to structure.

b. Type: Torque-controlled, expansion anchor .

c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.

d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated .

E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings 1-1/2 inches (38 mm).

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.

2. Steel Studs and Tracks: ASTM C645.

a. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).

b. Depth: As indicated on Drawings .

3. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch (22 mm) deep.

a. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm) .

4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical or hat shaped.

G. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.

2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.

2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.

3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.

4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.

2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.

3. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb unless otherwise indicated.

b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.

c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:

1. Screw to wood framing.

2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 07 21 00 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm) o.c.

2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.

3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards .

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not attach hangers to steel roof deck.

6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.

7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.

8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 09 22 16 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Gypsum ceiling board.
4. Joint treatment materials.
5. Laminating adhesive.
6. Sound-attenuation blankets.
7. Acoustical sealant.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide 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. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Thickness: 5/8 inch (15.9 mm).

2. Long Edges: Tapered.

B. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Thickness: 5/8 inch (15.9 mm).

2. Long Edges: Tapered.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

2. Exterior Gypsum Soffit Board: Paper.

3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.

4. Finish Coat: For third coat, use setting-type, sandable topping compound.

5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.

2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.5 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

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 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

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 (1.5 mm) 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. (0.7 sq. m) 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- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) 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.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

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.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on Drawings.

2. Type X: Where required for fire-resistance-rated assembly

3. Ceiling Type: Ceiling surfaces.

4. Abuse-Resistant Type: As indicated on Drawings.

5. Impact-Resistant Type: As indicated on Drawings.

6. Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.

2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

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 for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

2. Level 2: Panels that are substrate for tile.

3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

4. Level 5: Locations indicated, to receive wall mural/graphic.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.5 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Stone thresholds, installed as part of tile installations.
3. Waterproof membrane, for thin set tile installations.
4. Crack isolation membrane, for thin set tile installations.
5. Tile backing panels.
6. Metal edge strips.

B. Related Sections:

1. Section 07 92 00 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 09 29 00 "Gypsum Board" for cementitious backer units.

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 plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum ≥ .60.

1.5 ACTION 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.

C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of product, signed by product manufacturer.

C. Material Test Reports: For each tile-setting and -grouting product and special purpose tile.

1.7 MAINTENANCE MATERIALS

A. Furnish extra materials that match and are from same production runs as 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 1 unopened carton for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type from one source or producer.

1. Obtain tile of each type and color or finish 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 one 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 from a single manufacturer for each product:

1. Stone thresholds.
2. Waterproof membrane.

3. Crack isolation membrane.
4. Joint sealants.
5. Metal edge strips.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.Section 014000 "Quality Requirements" states "build mockups in location and of size indicated or, if not indicated, as directed." Consider inserting size and location requirements in first two subparagraphs below or showing on Drawings.

1. Build mockup of each type of wall tile installation.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.9 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 requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.10 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.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, 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.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

A. Tile Type CT-1: Porcelain Wall Tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Argent 2.0 or comparable product by one of the following:

a. Shaw Contract (basis of design)
b. Daltile; Division of Dal-Tile International Inc.
c. Florim USA.
d. Laufen.
e. Trinity Tile.

1. Composition: Porcelain
2. Module Size: 6 x 12 inches
3. Style: Vein Cut Cove Base Matte CT87J
4. Tile Color and Pattern: Mirror 00150.
5. Grout Color: Silver 00030

B. Tile Type CT-2: Porcelain Wall Tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Argent 2.0 or comparable product by one of the following:

a. Shaw Contract (basis of design)
b. Daltile; Division of Dal-Tile International Inc.
c. Florim USA.
d. Laufen.
e. Trinity Tile.

2. Composition: Porcelain
3. Module Size: 6 x 24 inches (cut in field)
4. Style: Vein Cut Matte CT87J
5. Tile Color and Pattern: Mirror 00150.
6. Grout Color: Silver 00030

C. Tile Type CT-3: Porcelain Wall Tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Argent 2.0 or comparable product by one of the following:

    a. Shaw Contract (basis of design)
    b. Daltile; Division of Dal-Tile International Inc.
    c. Florim USA.
    d. Laufen.
    e. Trinity Tile.

2. Composition: Porcelain
3. Module Size: 12 x 24 inches
4. Style: Vein Cut Matte CT87J
5. Tile Color and Pattern: Mirror 00150.
6. Grout Color: Silver 00030

D. Tile Type CT-4: Porcelain Wall Tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Argent 2.0 or comparable product by one of the following:

    a. Shaw Contract (basis of design)
    b. Daltile; Division of Dal-Tile International Inc.
    c. Florim USA.
    d. Laufen.
    e. Trinity Tile.

2. Composition: Porcelain
3. Module Size: 12 x 12 inches
4. Style: Vein Cut Mosaic Matte CT89J
5. Tile Color and Pattern: Mirror 00150.
6. Grout Color: Silver 00030

E. Tile Type CT-5: Porcelain Wall Tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Argent 2.0 or comparable product by one of the following:

    a. Shaw Contract (basis of design)
    b. Daltile; Division of Dal-Tile International Inc.
    c. Florim USA.
    d. Laufen.
    e. Trinity Tile.

2. Composition: Porcelain
3. Module Size: 3 x 12 inches
4. Style: Vein Cut Bullnose Matte CT90J
5. Tile Color and Pattern: Mirror 00150.
6. Grout Color: Silver 00030

F. Tile Type CT-6: Porcelain Wall Tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Argent 2.0 or comparable product by one of the following:

   a. Landmark Ceramics (basis of design)
   b. Daltile; Division of Dal-Tile International Inc.
   c. Florim USA.
   d. Laufen.
   e. Trinity Tile.

2. Composition: Porcelain
3. Module Size: 3 x 24 inches
4. Style: Explore
5. Tile Color and Pattern: Everest Dark.
6. Grout Color: to be selected by Architect from manufacturers standard line

G. Tile Type PV-1: Porcelain Tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crossville Argent 2.0 or comparable product by one of the following:

   a. Landmark Ceramics (basis of design)
   b. Daltile; Division of Dal-Tile International Inc.
   c. Florim USA.
   d. Laufen.
   e. Trinity Tile.

1. Composition: Porcelain
2. Module Size: 6 x 24 inches
3. Collection: Pro Ledgestone
4. Tile Color and Pattern: Ridge Gray
5. Grout Color: As selected by Architect from manufacturer's full range.
6. Trim Units: Schluter Quadec, Q125AT, Color: Brushed Stainless.

2.3 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

B. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of 12 per ASTM C 1353 or ASTM C 241 and with honed finish.

1. Description: Uniform, fine- to medium-grained crema saddle marble.

2.4 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.

2.5 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer by one of the following:

1. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:

1) Boiardi Products; a QEP company; Elastiment 344 Reinforced Waterproofing and Anti-Fracture/Crack Suppression Membrane.
2) Bonsal American; an Oldcastle company; B 6000 Waterproof Membrane with Glass Fabric.
3) Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
4) Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.
5) MAPEI Corporation; Mapelastic L (PRP M19).
6) Or equal as approved by the Professional.

2.6 SETTING MATERIALS

A. Modified Dry-Set cement mortar (Thin Set): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C-Cure.
b. Custom Building Products.
c. Laticrete International, Inc.
d. MAPEI Corporation.
e. Mer-Kote Products, Inc.

2. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene- butadiene-rubber liquid latex additive at Project site.

2.7 GROUT MATERIALS

A. Standard Cement Grout and Standard Non-Sanded Cement Grout: ANSI A118.6.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C-Cure.
b. Custom Building Products.
c. Laticrete International, Inc.
d. MAPEI Corporation.
e. TEC; a subsidiary of H. B. Fuller Company.

B. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.8 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 079200 "Joint Sealants."

1. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; Dow Corning 786.
b. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
c. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
d. Tremco Incorporated; Tremsil 600 White.

2.9 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; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

1. Basis of Design: Schluter QUADEC – for outside corners.

C. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.
2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

D. 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.

E. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

1. Products: Subject to compliance with requirements, provide one of the following:

a. C-Cure; Penetrating Sealer 978.
b. Custom Building Products; Grout and Tile Sealer.
c. MAPEI Corporation; Ultracare Grout Sealer, Keraseal Penetrating Sealer for Unglazed Grout and Tile.
d. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
e. TEC; a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

2.10 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 coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with adhesives or thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. 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.
4. 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. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

C. Blending: For tile exhibiting color variations, 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.

D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:

    a. Tile floors in wet areas.
    b. Tile floors composed of tiles 8 by 8 inches (200 by 200 mm) or larger.

B. 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.

C. 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.

D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Porcelain Tile: 1/8 inch (3.2 mm).
2. Glazed Wall Tile: 1/16 inch (1.6mm).

F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).
2. Do not extend waterproofing or crack isolation membrane under thresholds set in dry-set portland cement or latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on waterproofing or crack isolation membrane with elastomeric sealant.

H. Metal Edge Strips: Install where exposed edge of tile flooring, base or wainscot meets carpet, wood, or other flooring that finishes flush with top of tile and where cap tile is not available.

I. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 TILE BACKING PANEL INSTALLATION

A. Install cementitious backer units and fiber-cement underlayment 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.

3.5 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.6 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

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 and latex-portland cement 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.
3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

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 protective cleaner from tile surfaces.

3.8 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Masonry or Concrete:

1. Tile Installation W202: Thin-set mortar; TCA W202.

a. Tile Type: CT-1 through CT-2.
b. Thin-Set Mortar: Latex- portland cement mortar.
c. Grout: Standard unsanded cement grout.

END OF SECTION 09 30 00

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Acoustical tiles for ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6-inches- (150-mm-) in size.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and

ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical tile ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E 1264 for Class B materials.

2.2 ACOUSTICAL TILES, GENERAL

A. Source Limitations: Obtain each type of acoustical ceiling tile and supporting suspension system from single source from single manufacturer.

B. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.

2.3 ACOUSTICAL TILES (ACT-1)

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Armstrong World Industries, Inc., #2822 Calla Tegular 24”x24” (Basis of design)

B. Color: White.

C. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Armstrong World Industries, Inc., #8499 Lyra Vector 48”x48” (Basis of design)

D. Color: White

E. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical tiles treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or

bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension-System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Postinstalled expansion or Postinstalled bonded anchors.

b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

D. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical tiles in-place.

2.5 METAL SUSPENSION SYSTEM.

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Armstrong World Industries, Inc., 15/16” Prelude XL, white. (Basis of design)

B. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, G30 (Z90) coating designation.

1. Structural Classification: Intermediate-duty system.

2. Access: Upward and end pivoted or side pivoted, with initial access openings of size indicated below and located throughout ceiling within each module formed by main and

cross runners, with additional access available by progressively removing remaining acoustical tiles.

a. Initial Access Opening: In each module, 24 by 24 inches (610 by 610 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.

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

3.2 PREPARATION

A. Testing Substrates: Before installing adhesively applied tiles on wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.

B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

8. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.

9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

D. Arrange directionally patterned acoustical tiles as follows:

1. As indicated on reflected ceiling plans.

3.4 CLEANING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095123

SECTION 096513 - RESILIENT 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE RB-1

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. Johnsonite.

b. Roppe Corporation, USA. (Basis of design)

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Rubber Type TS

2. Style: Draft #20

C. Height: 4”.

D. Lengths: Coils in manufacturer's standard length.

E. Outside Corners: Job formed or preformed.

F. Inside Corners: Job formed or preformed.

G. Colors and Patterns: 123 Charcoal

2.2 RESILIENT BASE RB-2

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. Johnsonite.

b. Roppe Corporation, USA. (Basis of design)

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Rubber Type TS

2. Style: Draft #20

C. Height: 4”.

D. Lengths: Coils in manufacturer's standard length.

E. Outside Corners: Job formed or preformed.

F. Inside Corners: Job formed or preformed.

G. Colors and Patterns: 147 Light Brown (installed at casework)

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

3.3 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.

1. Apply two coat(s).

C. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 095619 - RESILIENT TILE FLOORING

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 DESCRIPTION

A. Work included: Provide Resilient tile flooring and base where indicated on the Drawings, as specified herein, and as needed for a complete and proper installation.

1.3 QUALITY ASSURANCE

A. Provide each type of resilient flooring and accessories as produced by a single manufacturer, including recommended primers, adhesives, sealant, and leveling compounds

B. All resilient flooring shall comply with the following;

1. ASTM F 1066, Comp. 1, Class 2
2. SS-T-312b, Type IV, Comp. 1
3. MIL STD - 1623D for Deck Covering
4. ASTM E 648; NFPA-253; Critical Radiant Flux - 0.45 watts/cm² or greater×
5. ASTM E 662; NFPA-258; NBS Smoke Density - 450 or less

C. Stair Tread components shall comply with

1. FS RR-T-650d, Composition B, Type II, Vinyl.
2. ASTM E-648, Class 1 fire rating.
3. ASTM D-2047, Test for Static Coefficient of Friction.
4. OSHA and ADA requirements.

1.4 SUBMITTALS

A. Within 21 days of Notice to Proceed, submit the following:

1. Manufacturer name;
2. Tile name, series, pattern;
3. Color samples for Owner's review and selection from standard available colors

1.5 EXTRA STOCK

A. Deliver to the Owner an extra stock of approximately 5% of each type and color of flooring material, packaging each type of material separately, distinctly marked, and adequately protected against deterioration.

1.6 WARRANTY

A. Manufacturer shall provide standard 5 year limited warranty on materials from the date of substantial completion

B. Contractor shall guarantee all workmanship, for a period of one year commencing from the date of substantial completion. All required repairs within that period shall be provided at no cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Provide colors and patterns as selected by the Owner from standard colors and patterns of the approved manufacturer in the specified type.

B. Adhesives:

1. Provide waterproof and stabilized type adhesive as recommended by manufacturer of material being installed;

2. Asphalt emulsions and other non-waterproof adhesives will not be acceptable.

C. Concrete slab primer: Provide non-staining type as required and as recommended by manufacturer of material being installed.

2.2 RESILIENT MATERIALS

A. Vinyl Composition Tile: (LVT-1)

1. Dimensions: 6”x48”

2. Collectionr: Terrain II, 20 mil

3. Style: 4110V, 5 mm

4. Color: Grove 00769

5. Install: Stagger

B. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Shaw Contract (Basis of design)

2. Adhesives

a. As specified by manufacturer for each different product

C. Vinyl Composition Tile: (LVT-2)

1. Dimensions: 6”x48”

2. Collectionr: Terrain II, 20 mil

3. Style: 4110V, 5 mm

4. Color: Grove 00769

5. Install: Herringbone

D. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Shaw Contract (Basis of design)

3. Adhesives

a. As specified by manufacturer for each different product

E. Vinyl Composition Tile: (LVT-3)

1. Dimensions: 24”x24”

2. Collectionr: Cast, 20 mil

3. Style: 4098V, 5 mm

4. Color: Forum 98535

5. Install: Ashlar

F. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Shaw Contract (Basis of design)

4. Adhesives

a. As specified by manufacturer for each different product

G. Rubber Tile: (RT)

1. Dimensions: 24”x24”

2. Collectionr: Color Splash Speckled Rubber

3. Pattern: Hammered

4. Color: VF2 Oak Alley

H. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Johnsonite/Tarkett (Basis of design)

5. Adhesives

a. As specified by manufacturer for each different product

PART 3 - EXECUTION

3.1 PREPARATION

A. Subfloors:

1. The subfloor surface must be clean, dry, smooth, level, structurally sound, and free of extraneous materials including grease, wax, paint, and adhesive residue.

2. Fill cracks, holes, and uneven areas with a portland cement-latex patching compound.

B. Priming:

1. Apply concrete primer if so recommended by the resilient flooring manufacturer;

2. Apply in accordance with the manufacturer's recommendations as approved by the Professional.

C. Maintain minimum temperature of 68° F in spaces to receive resilient flooring for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Store resilient flooring materials in spaces where they will be installed for at least 48 hours before beginning installation. Subsequently, maintain minimum temperature of 55° F in areas where work is completed.

D. Install resilient flooring and accessories after other finishing operations, including painting, have been completed.

E. Verify that moisture and ph levels of all concrete slabs fully comply with the carpet research institute's guidelines. Test all concrete floors, using an anhydrous calcium chloride moisture test kit, to ensure that the concrete emits 3 lbs of moisture per 1000 s.f. per 24 hour period or less, prior to installing carpet. Test to ensure that that the concrete's ph range is between 5 and 9, inclusive, prior to installing carpet. If testing indicates that concrete fails to meet these criteria, correct the ph and moisture emissions before installing carpet, by supplying and installing “koster seal” or equal sealant to sufficiently encapsulate concrete floor slabs.

F. Maintain reference markers, holes, and openings that are in place or plainly marked for future cutting by repeating on the finish surface as marked in the subfloor. Use chalk or other non-permanent marking device.

3.2 INSTALLATION

A. Installing resilient tiles:

1. Place units with adhesive cement in strict compliance with manufacturer's recommendations as approved by the Professional:

   a. Butt units tightly to vertical surfaces, nosings, edges, and thresholds;

   b. Scribe as necessary around obstructions and to produce tight joints;

   c. Place tiles tightly laid, even, and in straight parallel lines;

   d. Extend units into toe spaces, door reveals, and in closets and similar spaces.

2. Lay units from center marks established with principal walls, discounting minor offsets, so that units at opposite edges of the room are of equal widths. Adjust as necessary to avoid use of widths of less than 3" at room perimeters.

3. Match units for color and pattern by using materials from cartons in the same sequence as manufactured and packaged.

4. Lay in ashlar pattern with tile grain all running in same direction unless otherwise directed by the Professional.

5. Place resilient edge strips tightly butted to units and secured with adhesive, providing at all unprotected edges unless otherwise shown.

B. Install base where shown on the Drawings, and using factory preformed exterior corners, and factory preformed or job mitered interior corners.

3.3 CLEANING AND PROTECTION

A. Avoid rolling loads and heavy traffic until tile is seated (minimum 48 hours). Thereafter, use plywood or hardboard to protect the floor when returning or moving furniture, appliances, or equipment.

B. Allow adhesive to dry a minimum of 48 hours before washing or waxing the floor.

C. Remove scuffs and adhesive smears with a neutral cleaner as recommended by manufacturer

D. Damp-mop with a dilute solution of Commercial No-Rinse Cleaner and rinse with water. Avoid flooding the floor.

E. Allow floor to dry and apply five thin coats of Commercial Floor Polish following all label instructions

F. Protect the floor with heavy kraft paper like FortiFiber Seekurer on construction sites where other trades are active. Do not use asphalt saturated felt or paper.

END OF SECTION 096519

SECTION 096710 - RESINOUS FLOORING

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. Resinous flooring systems with integral base.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for Initial Selection: For each type of exposed finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

B. Material Certificates: For each resinous flooring component, from manufacturer.

C. Material Test Reports: For each resinous flooring system.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer.

Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

C. Pre-installation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, basis of design product; Torginol

2.2 MATERIALS

A. VOC Content of Resinous Flooring: Provide resinous flooring systems, for use inside the weatherproofing system, that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Resinous Flooring: 100 g/L.

2.3 RESINOUS FLOORING (EPX-1)

A. Resinous Flooring: Abrasion-, impact- and chemical-resistant, decorative-aggregate-filled, epoxy-resin-based, monolithic floor surfacing designed to produce a seamless floor with integral base.

B. System Characteristics:

1. Color: Husky FB-4211

2. Wearing Surface: Textured for slip resistance.

3. Overall System Thickness: 35 mils (.89 mm).

4. Style: Terrazzo Flake.

C. Base Coats:

1. Application Method: Roller or squeegee applied.

a. Thickness of Coats: 20 mils (.51mm).

b. Number of Coats: One.

2. Aggregates: 1/8” Flake, Full Coverage.

D. Topcoat: Sealing or finish coats.

1. Resin: Chemical Resistant Polyaspartic.

2. Thickness of Coats: 15 mils (.38mm).

3. Type: Clear.

4. Number of Coats: One

2.4 ACCESSORIES

A. Primer: Type recommended by manufacturer for substrate and body coats indicated.

B. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coats indicated.

C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

a. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.

3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab area in 24 hours.

b. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.

c. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.2 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.

2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.

3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply self-leveling slurry body coats in thickness indicated for flooring system.

1. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.

D. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096710

SECTION 099123 - INTERIOR PAINTING

GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.

2. Step coats on Samples to show each coat required for system.

3. Label each coat of each Sample.

4. Label each Sample for location and application area.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Benjamin Moore (Basis of design)

2. PPG (Existing Storefront)

3. See plans for color, finish and location.

B. Paint (PNT-1):

1. Benjamin Moore Scuff-X

2. Color: CW-715 Bone Black

3. Finish: Eggshell

C. Paint (PNT-2):

1. Benjamin Moore Scuff-X

2. Color: 968 Dune White

3. Finish: Eggshell

D. Paint (PNT-3):

1. Benjamin Moore Scuff-X

2. Color: HC-113 Louisburg Green

3. Finish: Eggshell

E. Paint (PNT-4):

1. Benjamin Moore Scuff-X

2. Color: 2140-30 Dark Olive

3. Finish: Eggshell

F. Paint (PNT-5):

1. Benjamin Moore Scuff-X

2. Color: 2134-30 Iron Mountain

3. Finish: Semi-gloss

G. Paint (PNT-6):

1. Benjamin Moore high heat enamel coating

2. Color: Match wall color

H. Paint (PNT-7):

1. PPG Building Renewal NeverFade Metal Coating with Kynar Aquatec Technology

2. Color: To be selected by Architect from manufacturers standard line

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

1. Flat Paints and Coatings: 50 g/L.

2. Nonflat Paints and Coatings: 150 g/L.

3. Dry-Fog Coatings: 400 g/L.

4. Primers, Sealers, and Undercoaters: 200 g/L.

5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.

6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.

7. Pretreatment Wash Primers: 420 g/L.

8. Floor Coatings: 100 g/L.

9. Shellacs, Clear: 730 g/L.

10. Shellacs, Pigmented: 550 g/L.

D. Low-Emitting Materials: Interior paints and coatings 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."

E. Colors: see plans.

2.3 PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: MPI #50.

2.4 WATER-BASED PAINTS

A. Latex, Interior, (Gloss Level 2): MPI #44.

B. Latex, Interior, Semi-Gloss, (Gloss Level 5): MPI #54.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.

2. Wood: 15 percent.

3. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. CMU Substrates: Verify that mortar is fully cured.

F. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

G. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.

2. Sand surfaces that will be exposed to view, and dust off.

3. Prime edges, ends, faces, undersides, and backsides of wood.

4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.

2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 099123

3.3 APPLICATION

A. Apply high-performance coatings in accordance with manufacturer's written instructions.

B. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections.

3.4 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates:

1. Pigmented Flouropolymer over High-performance bonding primer:

a. Prime Coat: Bonding Primer, for metal. BR-W1650 (3.0 Mils Wet; 1.0 Mil Dry)

b. Topcoat: Flouropolymer, one component, pigmented, semigloss. BR Neverfade Metal Restoration Topcoat (5.0-6.0 Mils Wet; 2.0 Mils Dry)

END OF SECTION 099611

BARRY ISETT & associates INC

MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 10

Specialities

SECTION 102126 - WETWALL WATERPROOF WALL PANEL SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wetwall Waterproof Wall Panel System.

B. Panel adhesive and color coordinated sealants.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry.

B. Section 09 2900 - Gypsum Board.

1.03 REFERENCES

A. Reference Standards:

1. ASTM C412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Rubber.
2. ASTM C661: Standard Test Method for Indentation Hardness of ElastomericType Sealants by Means of a Durometer.
3. ASTM C920: Standard Specification for Elastomeric Joint Sealants.
4. ISO: International Organization for Standardization.
5. ISO 4586: High-Pressure Decorative Laminate (HPDL) – Sheets Based on Thermosetting Resins.
6. ISO 9001: Quality Management Systems - Requirements.

1.04 SUBMITTALS

A. General: Submit under provisions of Section 01 3000 - Submittals.

B. Product Data: For each specified product. Include manufacturer’s technical data sheets and published instruction instructions.

1. Submit Safety Data Sheets (SDS) for adhesives and sealants.

C. Shop Drawings: Fully dimensioned shop drawings indicating wall panel and mounting system layouts, joinery and reveals, terminating conditions, substrate construction, cutouts, and holes. Include elevations, sections, and large-scale details; show attachment locations, fastener spacings, blocking, and related components.

D. Samples: Selection and verification samples for each wall panel color, pattern, and finish required.

1. Submit minimum 5x8 inch sample of each wall panel required. Include two samples joined together representing typical exposed panel joint condition.

E. Quality Assurance Submittals: Submit the following:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties, if required by authorities having jurisdiction.

2. Warranty: Specimen copy of specified warranty.

F. Maintenance Data: Submit manufacturer's published maintenance manual with closeout submittals.

1.05 QUALITY ASSURANCE

A. Non-certified Installer Qualifications: Documented experience in installing wall panels similar in scope and complexity to this Project.

B. Certified Platinum Installer Qualification: Minimum of five years documented installation experience for projects similar in scope and complexity to this Project, and currently certified by the manufacturer as an acceptable installer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer. Store panels flat on pallets or similar rack-type storage to preclude damage.

B. Ensure wall panels acclimate to installation area final occupancy temperature and humidity a minimum of 48 hours prior to time of installation.

C. Handling: Use extra care for front faces of panels. Use only non-abrasive cloths to avoid scratching finished surfaces.

1.07 PROJECT CONDITIONS

A. Environmental Requirements: Prior to installation, building must be enclosed with building interior spaces to receive the work climate-controlled, with a typical ambient temperature between 55 deg F and 80 deg F, and 40 percent to 50 percent relative humidity.

B. Field Measurements: Verify actual measurements and openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.08 WARRANTY

A. Manufacturer's Certified Platinum Installer Limited Lifetime Warranty: Provide manufacturer's standard Limited Lifetime Warranty against material defects in wall panel system.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Basis of Design Manufacturer: Wetwall, A Wilsonart Company.

2.02 WALL PANEL COMPONENT PROPERTIES

A. High Pressure Laminate Overlays on Panel Core Material: Decorative surface papers impregnated with melamine resins and pressed over an engineered composite core. Sheets then bonded together under pressures greater than 1,000 lbs. per sq. in. and high temperatures approaching 300 deg F. Finished sheets trimmed; backs sanded to facilitate bonding to substrate, unless selected products are unsanded. Wall panels must have balanced laminate surfaces (both sides of panel).

B. Panel Core Material: Engineered composite panel product composed of cellulosic materials, glass fibers, polypropylene and a bonding agent, resulting in a durable and dimensionally stable substrate suitable for decorative laminate overlays.

C. Enhanced Laminate Performance: all panel designs incorporate AEON Enhanced Scratch & Scuff-Resistant Performance Technology and antimicrobial protection.

2.03 WETWALL PANELS (WW)

A. Product: "Wetwall Waterproof Wall Panel System."

B. Panel Dimensions and Weight:

1. Panel Size (Width and Height): As selected from manufacturer's full range of sizes.
2. Panel Thickness: 0.41-inch nominal.
3. Panel Weight: Approximately 1.65 lb/sq. ft.

C. Panel Designs:

1. Design Pattern and Color: Staccato W7004

D. Panel Edge Configurations: Provide the following to suit installation conditions:

1. Tub/Shower Surrounds: Combination bullnose edge/flat edge, tongue edge/flat edge and groove edge/flat edge mated panels.
2. Panels Extending Beyond Surrounds: Tongue edge and groove edge.
3. Wing Walls: Combination flat and bullnose.
4. Feature Panels: Two bullnose edges.

E. Panel Performance Criteria: Based on testing pursuant to ISO 4586, for the following properties:

1. Light Resistance: Slight effect; Test Methods 32A and 33B.
2. Resistance to Staining: Not more than slight effect; Test Method 30A.
3. Resistance to Staining: 10; Test Method 31B.
4. Resistance to Wet Heat: No effect (non-gloss finishes) or slight effect (gloss finishes); Test Method 42.
5. Resistance to Dry Heat: No effect (non-gloss finishes) or slight effect (gloss finishes); Test Methods 17A and 18B.
6. Resistance to Impact (Large): 40 inches; Test Method 25.
7. Resistance to Cigarette Burn: 210 seconds; Test Method 37.
8. Dimensional Stability 0.5 percent (machine direction) and 0.8 percent (cross direction); Test Method 22B.

2.04 ACCESSORY MATERIALS

A. Adhesive and Sealant Product Compositions: One component, high modulus, mildew resistant multipurpose silyl-terminated polyether (hybrid) elastomeric products for use as an adhesive and sealant. Complies with ASTM C920, Type S, Grade NS, Class, Use NT, A, M, G. Performance Criteria:

1. Tensile Strength: 225 psi; ASTM D412.
2. Hardness, Shore A: 46; ASTM C661.
3. VOC: 18 g/L.

B. Panel Adhesive: Wilsonart® Adhesive “Panel Adhesive.”

1. Adhesive Color: White.

C. Color Coordinated Sealant: Wilsonart® Sealant “Color Coordinated Panel Sealant."

1. Sealant Color: To be selected by Architect from manufacturers standard line.

2.05 INSTALLATION

A. Cut components in shop, to greatest extent practicable, in panel sizes and arrangements indicated according to approved shop drawings and manufacturer’s published fabrication requirements.

B. Provide cutouts for wall penetrations, trim edges according to manufacturer's published requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions that could adversely affect the work of this Section.

B. Verify installation substrate materials are acceptable to receive the specified wall panels.

C. Substrates to receive wall panels must be sound, flat, smooth, dry, and free from dust, loose paint, or other surface contaminants.

D. Commencement of work will constitute acceptance of substrates and conditions to receive the work.

3.02 PREPARATION, GENERAL

A. Substrates to receive wall panels must be dry, smooth, and free from dust, dirt, and other surface contaminants.

B. Substrate surfaces must be plumb and square.

C. Prepared surfaces must be dry, smooth, and free of any dust or other contaminants.

D. Wipe prepared surfaces with a damp cloth and allow to dry.

3.04 WALL PANELS INSTALLATION

A. General: Install wall panels plumb, level, and true according to approved shop drawings and manufacturer's published installation instructions, including "Wetwall Waterproof Wall Panel System Installation Guide."

B. Tape over shower (or tub) drains prior to panel installation.

C. Cut panels using only approved power tools.

D. Dry fit panels, then mark plumbing locations for shower valves, shower heads, and similar items. Drill holes using only approved power tools.

E. Thoroughly clean panel backs prior to adhesive application on panel surfaces. Apply adhesive with bead dimensions, spacing, and locations from panel edges according to manufacturer's recommendations. Press into place on installation substrates to ensure full adhesive contact.

F. Apply color coordinated sealant to tongue edge panel prior to installation on wall surfaces. After panels are installed on substrates, apply color coordinated sealant to corners and bottoms for a watertight installation. Remove excess sealant from panel surfaces. Allow to cure for 24 hours.

3.05 CLEANING AND PROTECTION

A. Clean wall panels according to manufacturer's published maintenance instructions. Completely remove deleterious substances from finished surfaces using approved cleaning materials.

B. Protect completed work from damage during remainder of construction period.

3.06 SCHEDULE

END OF SECTION 10 2126

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Impact-resistant wall coverings.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide handrails capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.

2. Concentrated load of 200 lbf (0.89 kN) applied in any direction.

3. Uniform and concentrated loads need not be assumed to act concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each impact-resistant wall protection unit. Include sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long.

1.5 INFORMATIONAL SUBMITTALS

A. Material certificates.

B. Material test reports.

C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

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

B. Surface-Burning Characteristics: As determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

C. Regulatory Requirements: Comply with applicable provisions in ICC/ANSI A117.1.

1.8 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: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of design products:

1. Construction Specialties.

2. Wolf Gordon

3. Marlite

B. Wall Protection (WP-1):

1. Construction Specialties, Acrovyn dimensional moldings.

2. Texture: Beadboard

3. Thickness: .040”

4. Color: Dark Moss #113, with color matching caulk at seams

5. Trim/Base: See Finish Legend Sheet A1.15 for trims, corner guards and wall base.

C. Wall Protection (WP-2):

1. Wolf Gordon, Rampart Resolve PVC Free.

2. Style: GOH 35441997 Intertwine

3. Color: ITW 5898 Sage

4. Trim/Base: See Finish Legend Sheet A1.15 for trims, corner guards and wall base.

D. Wall Protection (FRP):

1. Marlite Standard FRP.

2. Finish: Pebbled

3. Color: P 43N Medium Gray

4. Corner Guards: F560SS

E. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft-lbf/in. (800 J/m) of notch when tested according to ASTM D 256, Test Method A.

F. 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.

G. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with 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

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 (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches (305 mm).

    c. Adjust end and top caps as required to ensure tight seams.

B. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

C. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

BARRY ISETT & associates INC
MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 12

Furnishings

SECTION 12 35 40 - MANUFACTURED PLASTIC-LAMINATE-FACED CASEWORK

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 plastic-laminate-faced cabinets of stock design.

B. Related Requirements:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" or wood blocking for anchoring casework.
2. Section 09 22 16 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring casework.
3. Section 09 65 13 "Resilient Base and Accessories" for resilient base applied to plastic-laminate-faced casework.
4. Section 22 40 00 “Plumbing Fixtures” for Stainless Steel Sinks and Fixtures.

1.3 DEFINITIONS

A. Definitions in the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" apply to the work of this Section.

B. MDF: Medium-density fiberboard.

C. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.4 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

B. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying requirements.

1.5 COORDINATION

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

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.

C. Keying Schedule: Include schematic keying diagram and index each key set to unique designations that are coordinated with the Contract Documents.

D. Samples: For cabinet finishes.

E. Samples for Initial Selection: For cabinet finishes.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation of units required for this Project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.10 MAINTENANCE MATERIAL

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide one unopened box of each of the following:

a. Vent Louvers
b. Coat Hooks
c. Shelf Clips
d. Locks

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install casework 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. Maintain temperature and relative humidity during the remainder of the construction period in range recommended for Project location by the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed and indicate measurements on Shop Drawings.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of components or other failures of glue bond.
b. Warping of components.
c. Failure of operating hardware.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufactured Plastic Laminate Faced Casework: Subject to requirements, provide Mott Manufacturing, Inc, or provide equal products by one of the following

1. Case Systems.

2. TMI Systems Design Corporation.
3. Advanced Cabinet Systems (ACS)
4. AmeriCase
5. Mastercraft

B. Source Limitations: Obtain plastic-laminate-faced cabinets from single manufacturer.

2.2 CASEWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.

1. Grade: Custom.
2. Provide labels and certificated from AWI certification program indicating that casework, including installation, complies with requirements of grades specified.

B. Product Designations: Drawings indicate sizes, configurations, and finish materials of manufactured plastic-laminate-faced cabinets by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications may be considered. See Section 01600 "Product Requirements."

C. Product Designations: Drawings indicate configurations of manufactured plastic-laminate-faced cabinets by referencing designations of Casework Design Series numbering system in Appendix A of the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

D. Furnish all cabinets and casework including tops, splashes and supporting structures and all other miscellaneous items of equipment as listed in the specifications or equipment schedules or as shown on the drawings. Fabricate and deliver to building, unload, unpack, set in place, level and securely fasten and scribe to walls as required; ready for mechanical and electrical connections which will be done as specified under other divisions. All work shall be strictly in accordance with this specification.

E. Holes in counters for insertion of sinks and fixtures will be the responsibility of the casework supplier.

2.3 CASEWORK

A. Design:
1. Flush overlay, Basis-of-Design Mott Manufacturing
2. Laminate Products: Product must have comparable color selections to basis-of-design listed on drawing finish legend.
3. Provide ADA sink enclosures per drawing details and in conjunction with accessibility requirements.

B. Exposed Materials:

1. Plastic Laminate (casework): (HPL-1) Grade HGS.

2. Wilsonart (basis of design)

3. Color: Slate Gray D91-60

a. Colors for other cabinet surfaces, grade GP28, Maximum of one (1) color to be selected per unit face and six (6) colors for the project. Refer to drawings for laminate manufacturer and color selections.
b. Colors for countertop grades, GP50 and PF42, shall be selected from the current year Plastic Laminate complete solid and pattern offering. A maximum of six (6) colors selections. Refer to drawings for laminate manufacturer and color selections.

4. Unless otherwise indicated, provide specified edgebanding on all exposed edges.

C. Semi-exposed Materials:

1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semi-exposed surfaces unless otherwise indicated.

a. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.

2. Unless otherwise indicated, provide specified edgebanding on all semi-exposed edges.

D. Concealed Materials:

1. Particleboard.

2.4 PLASTIC-LAMINATE COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.

1. Provide labels and certificates from \AWI certification program indicating that countertops comply with requirements of grades specified.

B. Grade: Custom.

C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.

D. 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 indicated by manufacturer's designations.
2. Grain Direction: Parallel to cabinet fronts.

E. Edge Treatment: 3-mm PVC edging.

F. Core Material: Particleboard.

G. Core Material at Sinks: Particleboard made with exterior glue made with exterior glue or exterior-grade plywood.

H. Core Thickness: 1 1/8 inch.

2.5 MATERIALS

A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.

C. Softwood Plywood: DOC PS 1.

D. Particleboard: ANSI A208.1, Grade M-2.

E. MDF: ANSI A208.2, Grade 130.

F. Hardboard: ANSI A135.4, Class 1 Tempered.

G. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Manufacturers: Provide laminate selections as indicated on the finish plan drawings.

H. Edgebanding for Plastic Laminate: PVC 3mm edgebanding typical, to match adjacent plastic laminate.

I. Edgebanding for Thermoset Decorative Panels: PVC 3mm edgebanding typical, to match adjacent plastic laminate.

2.6 COLORS AND FINISHES

A. Wood Colors and Finishes: As selected by Architect from casework manufacturer's full range.

B. Plastic-Laminate Colors, Patterns, and Finishes: As selected by Architect from casework manufacturer's full range. Refer to Finish Plan drawings for selections.

2.7 CASEWORK HARDWARE AND ACCESSORIES

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.

1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

B. Butt Hinges: Chrome-plated, semi-concealed, five-knuckle overlay hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two hinges for doors less than 48 inches (1220 mm) high, and provide three hinges for doors more than 48 inches (1220 mm) high.

C. Pulls: Solid aluminum or chrome-plated brass wire pulls, fastened from back with two screws. For sliding doors, provide recessed chrome-plated flush pulls. Provide two pulls for drawers more than 24 inches (600 mm) wide.

D. Drawer Slides: BHMA A156.9, Type B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated, steel ball-bearing slides.

E. Drawer and Hinged Door Locks: Cylindrical (cam) type, five-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.

1. Provide a minimum of two keys per lock and six master keys.
2. Provide locks where indicated.

F. Adhesive shall have a VOC content of 50 g/L or les when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Manufacturers standard. Color to be selected by Architect from manufacturer's full range.

G. Wall Mounted Standards: Provide channel type, extruded aluminum standard mounted om walls and designed to hold shelf support brackets inserted into channel ends or access slots and slid to desired position.

1. Mounting: Surface.
2. Length: As Indicated on Drawings.
3. Profile: Basic Channel .700 inch (18-mm) wide by .535 inch (14-mm) deep with projecting lips to retain shelf brackets and designed for surface mounting.

H. Shelf Support Brackets: Provide rectangular bracket fabricated from 1/4 inch (4 mm) thick extruded aluminum bar with steel pin to retain and hold bracket in support channel.

1. Depth: 2 inches (51 mm).
2. Finish: Clear Anodized.
3. Retaining Pins: 5/32 inch (4 mm) diameter by .3 inch (8 mm) long steel pin to secure shelf from shifting on bracket.
4. Shelf Couplers: 1 inch (25 mm) wide PVC extrusion pinned to top of bracket for supporting two adjoining shelves. Coupler is pre-drilled to allow shelves to be attached to screws. Color: Translucent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of the Work.

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

3.2 CASEWORK INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Install casework level, plumb, and true; shim as required, using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm). Bolt adjacent cabinets together with joints flush, tight, and uniform.

D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).

E. Fasten cabinets to adjacent cabinets and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

G. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF TOPS

A. Field Jointing: Where possible, make in the same manner as shop jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project site processing of top and edge surfaces is not required. Locate field joints where shown on approved Shop Drawings.

B. Fastenings: Except for epoxy and phenolic-composite tops, use concealed clamping devices for field joints located within 6 inches of front, at back edges, and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

1. Secure tops, except for epoxy tops, to cabinets with Z-type fasteners or equivalent, using 2 or more fasteners at each front, end, and back.

C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection. Provide flush hairline joints in tops using clamping devices.

1. Where necessary to penetrate tops with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal to top in chemical resistance, hardness, and appearance.

D. Provide required holes and cutouts for service fittings.

E. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

F. Provide scribe moldings for closures at junctures of top, curb, and splash, with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

3.4 INSTALLATION OF SINKS

A. Set top edge of sink unit in sink and top manufacturers' recommended chemical-resistant sealing compound and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement.

B. Semi-flush Installation: Use stainless-steel sink frame, complete with clamping lugs and pads. Before setting, apply a full coat of sink and top manufacturers' recommended sealant under rim lip and along top. Omit sink frame if sink is fabricated with an integral rim seal.

C. Drop-in Installation: Rout groove in top to receive sink rim if not prepared in shop. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and top manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.

3.5 CLEANING

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

3.6 COORDINATION OF STORAGE SHELVING

A. Coordinate provision of shelving system with location of other wall and ceiling mounted components such as but not limited to visual display boards, casework, structural framing, light fixtures and air diffusers to eliminate potential conflicts.

B. Coordinate requirements for stud spacing, blocking and auxiliary structural supports to ensure adequate means for installation of shelving system.

C. Coordinate installation of shelving system with application of wall and ceiling finishes. To the extent possible install shelving components after finishes have been applied.

3.7 INSTALLATION OF STORAGE SHELVING

A. Install shelving system and accessories in accordance with approved shop drawings and manufacturers installation instructions.

B. Install shelving at locations and heights indicated on the drawings. Verify locations in field with Owner and Architect.

C. Install standards and other support components rigidly to supporting substrate so that components are secure, plumb and level.

D. Install with fasteners of type, size and quantity as supplied or recommended by shelving manufacturer for type of application and substrate.

E. Ensure screws used to anchor wall standards are set flush and do not project into channel.

F. Thoroughly clean and polish storage system components and protect from subsequent construction activities. Remove and replace damaged components.

3.8 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 12 35 40

SECTION 123661 - SOLID SURFACE COUNTERTOPS

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. Solid-surface-material countertops and backsplashes.

2. Solid-surface-material window sills

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials and sinks.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS

A. Basis of design products:

1. Wilsonart

2. Formica

B. Countertops (SS-1)

1. Wilsonart

2. Color: Beige Travertine 9236SS

C. Countertops (SS-2)

1. Formica

2. Color: 737 Gray Galaxy

D. Countertops/Vanity (SS-3)

1. Formica

2. Color: 782 Luna Weather

E. Configuration: Provide countertops with the following front and backsplash style:

1. Front: 1-1/2-inch laminated bullnose.

2. Backsplash: Straight, slightly eased at corner.

3. Endsplash: Matching backsplash.

F. Countertops: 1/2-inch- thick, solid surface material with front edge built up with same material. Provide 3/4-inch thick particleboard backing.

G. Backsplashes: 1/2-inch- thick, solid surface material.

2.1 SOLID-SURFACE-MATERIAL WINDOW SILLS

A. Sills: 1/2-inch- thick, solid surface material with front edge built up with same material, with eased edges. Provide 1/2-inch thick particleboard backing.

2.2 COUNTERTOP MATERIALS

A. Certified Wood Materials: Fabricate countertops with wood and wood-based products 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. Composite Wood and Agrifiber Products: Provide products that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

C. Particleboard: ANSI A208.1, Grade M-2.

D. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

E. Adhesives: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Formica (Basis of design).

2. Type: Provide Standard Type unless Special Purpose Type is indicated.

3. Colors and Patterns: Refer to finish schedule for style and color

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

END OF SECTION 123661

BARRY ISETT & associates INC

MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 22

Plumbing

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:

1. Equipment installation requirements common to equipment sections.
2. Painting and finishing.
3. Concrete bases.
4. Supports and anchorages.
5. Access Panels

1.3 DEFINITIONS

A. Basis of Design Products:

1. The "basis of design" products named on the contract drawings and throughout the project manual constitute the engineer’s design.
2. The phrase "or comparable product by one of the following" throughout the project manual implies that the comparable products are accepted as equal; however, the conditions of AIA document A201-2007 regarding shop drawings, product data and samples apply with regards to deviations from the contract documents.
3. If products other than the "basis of design" differ from the engineer’s design to the extent that modifications to structural, mechanical, electrical, or any other affected discipline's design is required to install the product properly, then all such modifications shall be done at the expense of the Contractor.
4. Build American Design Submittals:
    a. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

B. 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.

C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

F. 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.

G. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.

2. PE: Polyethylene plastic.

3. PVC: Polyvinyl chloride plastic.

H. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

I. Substantial completion: The project stage where the work is sufficiently completed in accordance with the contract documents so the owner can occupy or utilize the scope area for its intended use. This shall be a date determined by the General Contractor in coordination with other trades and the building owner.

1. For phased construction projects, the date of substantial completion may be determined per major scope area or phase of the scope such that the date of substantial completion may not be the same date for all areas of the scope.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for 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.

D. Installing Contractor shall submit appropriate forms to Pennsylvania Department of Labor and Industry – Boiler Division for approval of boilers, unfired pressure vessels, or other equipment under their jurisdiction before installation of equipment. Contractor shall also submit appropriate fees. Contractor shall arrange for inspection and obtain approval for installation. If installation fails inspection, Contractor shall arrange for re-inspection until approval is granted.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for 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.

1.7 ACCESS PANELS

A. Contractor shall provide access panels for all concealed equipment, valves, strainers, control devices, cleanouts, traps, and other items and devices requiring maintenance or access for service, adjustment, balancing or manual operation.

1. General maintenance access panels ARE NOT shown on Drawings. Contractor installing the item requiring access shall coordinate locations, sizes, quantities, etc., and shall provide and install access panels as required. Door sizes shall be 12 inches x 12 inches for hand access, 18 inches x 18 inches for shoulder access and 24 inches x 24 inches for full body access where required.

a. In new construction, the Contractor for General Construction shall provide the rough framed opening, and in the case of flush, frameless access panels in gypsum board applications, shall perform all drywall finishing. The Contractor for General Construction shall paint all access panels that are not prefinished or are otherwise intended to be left exposed.

b. In existing constriction, the Contractor installing the item requiring access shall cut and patch the required openings and shall provide and install the access panels as required. Unless the surface where the access panel is cut in and patched is already specified to be finished by the General Contractor, the Contractor installing the item requiring access shall paint all access panels that are not prefinished or are otherwise intended to be left exposed.

1.8 LEAD TIMES

A. By submitting a bid for this scope of work, the bidding contractor accepts responsibility to provide all equipment included in their scope of work regardless of lead time. If any individual component or piece of equipment has a notably long lead time, it is the responsibility of the installing bidding contractor to schedule the progress of their submittal review and subsequent ordering of equipment so as to not delay the progress of the project.

1. If a piece of equipment or component has a substantial or variable lead time that the contractor suspects may impact the project schedule, it is their responsibility to submit for approval a suitable alternate product per the specifications that will be delivered in a timely manner and not impact the project schedule.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 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. Insulation shall be installed continuously through openings, hangers, and over valves and pipe fittings unless noted otherwise.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

M. Verify final equipment locations for roughing-in.

N. 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 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. Pressure-Seal Joints: Use only manufacturer’s listed tooling for installation of pressure-seal fittings.

1. Provide O-ring sealing elements compatible with the fluid conveyed.

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 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.

3.5 ROOF PENETRATIONS

A. All New Construction:

1. General Contractor shall provide and prepare openings in new work, including all wood blocking, for the proper engagement of work of other Contractors. Upon completion of work by other Prime Contractors affecting roofing work, General Contractor shall perform all required roofing work.

B. Existing Construction where new roofing is involved:

1. The Plumbing Contractor shall perform all cutting & patching of the existing construction, except for patching of the roofing assembly, which shall be by the General Contractor. The General Contractor shall provide all blocking and structural support for roof equipment curbs.

C. Existing Construction where existing roofing is to remain:

1. The Plumbing Contractor shall perform all cutting & patching of the existing construction, including patching of the roofing membrane, flashing, etc. The Plumbing

Contractor shall provide all blocking for roof equipment curbs for their equipment. Perimeter support for equipment curbs shall be by the General Contractor.

D. See architect’s specifications for further detail.

3.6 PAINTING

A. Painting of Plumbing systems, equipment, and components is specified in Section 099123 "Interior 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. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1.

END OF SECTION 220500

SECTION 220517 - SLEEVES AND SLEEVE SEALS 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. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Silicone sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low emitting materials.

C. Build American Design Submittals:

1. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Advance Products & Systems, Inc.

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

C. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

E. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Jay R. Smith Mfg. Co.

2. Zurn Industries, LLC.

B. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Metraflex Company (The).

2. Proco Products, Inc.

B. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

2. Designed to form a hydrostatic seal of 20 psig minimum.

3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

4. Pressure Plates: Carbon steel.

5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Metraflex Company (The).

2. Proco Products, Inc.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

C. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Dow Corning Corporation.

    b. GE Construction Sealants; Momentive Performance Materials Inc.

2. Sealant shall have a VOC content of 250 g/L or less.

3. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. May National Associates, Inc.; a subsidiary of Sika Corporation.

2. Sealant shall have a VOC content of 250 g/L or less.

3. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Smooth-On.

2. Sealant shall have a VOC content of 250 g/L or less.

3. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

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. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.

2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

2. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

3. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

4. Use silicone sealant to seal the space around outside of stack-sleeve fittings.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials.

3.3 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.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Use grout or silicone sealant to seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves.

b. Piping NPS 6 and Larger: Cast-iron pipe sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.

1) Exception: Not required for fixture piping through slab. EX: Water closet flange, floor drain, etc.

2) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Steel pipe sleeves.

b. Piping NPS 6 and Larger: Steel pipe sleeves.

5. Interior Partitions:

a. Piping Smaller Than NPS 6: Steel pipe sleeves.

b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS 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. Escutcheons.

2. Floor plates.

1.3 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Build American Design Submittals:

1. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. BrassCraft Manufacturing Co.; a Masco company.

2. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

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 insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.

b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.

c. Insulated Piping: One-piece steel with polished, chrome-plated finish.

d. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.

e. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.

f. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

g. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.

h. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.

i. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.

j. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

k. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.

l. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.

m. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.

n. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

o. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.

p. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.

q. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

r. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.

s. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish.

t. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

2. Escutcheons for Existing Piping to Remain:

a. Chrome-Plated Piping: Split-casting, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.

b. Insulated Piping: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.

e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.

f. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor plate.

2. Existing Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

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 ball valves.
2. Iron, single-flange butterfly valves.
3. Bronze swing check valves.

B. Related Sections:

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
3. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this 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.

1.4 ACTION 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 Build American Design Submittals:

1. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

1.7 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. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

D. Valve Sizes: Same as upstream piping unless otherwise indicated.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.

2. Solder Joint: With sockets according to ASME B16.18.

3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 LEAD FREE BRONZE BALL VALVES

A. 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. Aalberts IPS US: Apollo Valves.

b. Crane Co.; Crane Valve Group; Crane Valves.

c. Hammond Valve; a division of Milwaukee Valve Company.

d. Jomar Valve Company.

e. Lance Valves; a division of Advanced Thermal Systems, Inc.

f. Milwaukee Valve Company.

g. NIBCO INC.

h. 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.

k. Ends: Threaded, Soldered, or Press per schedule.
1) Press-End Connection Rating: Minimum 200 psig.

2.3 GENERAL PURPOSE BALL VALVES

A. 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. Aalberts IPS US: Apollo Valves.

b. Crane Co.; Crane Valve Group; Crane Valves.

c. Hammond Valve; a division of Milwaukee Valve Company.

d. Jomar Valve Company.

e. Lance Valves; a division of Advanced Thermal Systems, Inc.

f. Milwaukee Valve Company.

g. NIBCO INC.

h. 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.

k. Ends: Threaded, Soldered, or Press per schedule.

1) Press-End Connection Rating: Minimum 200 psig.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 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 following:

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.

b. American Valve, Inc.

c. Aalberts IPS US: 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; a division of Milwaukee Valve Company.

j. Jomar Valve Company.

k. Kitz Corporation.

l. Legend Valve.

m. Milwaukee Valve Company.

n. Mueller Steam Specialty; a division of SPX Corporation.

o. NIBCO INC.

p. Norriseal; a Dover Corporation company.

q. Red-White Valve Corporation.

r. Spence Strainers International; a division of CIRCOR International, Inc.

s. Sure Flow Equipment Inc.

t. 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.

h. Lead free for all domestic water service.

2.5 CHECK VALVES

A. Class 150, Lead Free, 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. Jomar Valve Company.

f. Kitz Corporation.

g. Milwaukee Valve Company.

h. NIBCO INC.

i. Red-White Valve Corporation.

j. 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.

B. Check Valves, Lead Free - PVC, Union-Type Ball Check:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.

b. GF Piping Systems: Georg Fischer LLC.

c. IPEX USA LLC.

d. NIBCO INC.

e. Spears Manufacturing Company.

2. Pressure Rating and Temperature: 125 psig, 150 psig, or other pressure at 73 deg F or other temperature. See Part 3 check valve schedule articles.

3. Body Material: PVC.

4. Body Design: Union-type ball check.

5. End Connections for Valves NPS 2 and Smaller: Detachable, socket or threaded. See Part 3 check valve schedule articles.

6. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket or threaded.

7. Ball: PVC.

8. Seals: EPDM- or FKM-rubber O-rings.

2.6 GATE VALVES

A. Gate Valves, Lead Free, Flanged Ends - Iron, OS&Y, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. JOMAR Valve.

b. Milwaukee Valve.

2. Standard: MSS SP-70, Type I.

3. CWP Rating: 200 psig.

4. Body Material: Gray iron with bolted bonnet.

5. Ends: Flange.

6. Trim: Bronze.

7. Disc: Solid wedge.

8. 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.

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 valves.

2. Butterfly Valve Dead-End Service: Single-flange (lug) type.

3. Throttling Service: Ball, or butterfly valves.

4. Domestic Water Pump-Discharge Check Valves:

a. NPS 3 and Smaller:

1) Bronze swing check valves with bronze disc.

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 6: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 VALVE SCHEDULE

A. Domestic Hot- and Cold-Water Distribution Piping:

1. Pipe NPS 6 and Smaller: All valves to be lead free.

a. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

b. Ball Valves: Two-piece, full port, bronze with stainless-steel trim.

1) Press-style valve ends are not acceptable.

c. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, stainless-steel disc.

d. Bronze Swing Check Valves: Class 150, bronze disc.

B. Above-Ground Domestic Water Service Piping:

1. Pipe NPS 3 and smaller: All valves to be lead free.

a. Ball Valves: Two-piece, full port, bronze with stainless-steel trim.

1) Press-style valve ends are not acceptable.

2. Pipe NPS 4 and larger: All valves to be lead free.

a. Gate Valves, Lead Free, Flanged Ends - Iron, OS&Y, Class 125.

C. General Service, Low-Pressure Compressed Air Piping – 150 psig or Less:

1. Pipe NPS 2 and smaller:

a. Ball Valves: Two-piece, full port, bronze with stainless-steel trim, threaded ends.

1) Press-style valve ends are not acceptable.

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. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal hanger-shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe-positioning systems.
10. Equipment supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental Product Declaration: For each product.
3. Health Product Declaration: For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

D. Build American Design Submittals:

1. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.

3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. B-line, an Eaton business.

b. Thomas & Betts Corporation; A Member of the ABB Group.

c. Unistrut; Part of Atkore International.

2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.

3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.

4. Channels: Continuous slotted channel with inturned lips.

5. Channel Width: Selected for applicable load criteria.

6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

8. Metallic Coating: Plain.

9. Paint Coating: Green epoxy, acrylic, or urethane.

10. Plastic Coating: PVC.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Empire Industries, Inc.

   b. Gripple Inc.

   c. Sioux Chief Manufacturing Company, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.

3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.

4. Channels: Continuous slotted carbon-steel channel with inturned lips.

5. Channel Width: Select for applicable load criteria.

6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

8. Metallic Coating: No coating

9. Paint Coating: Green epoxy, acrylic, or urethane.

10. Plastic Coating: PVC.

2.5 THERMAL HANGER-SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Buckaroos, Inc.

2. National Pipe Hanger Corporation.

3. Pipe Shields Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Hilti, Inc.

b. ITW Ramset/Red Head; Illinois Tool Works, Inc.

B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. B-line, an Eaton business.

b. Hilti, Inc.

c. ITW Ramset/Red Head; Illinois Tool Works, Inc.

2. Indoor Applications: Zinc-coated or stainless steel.

3. Outdoor Applications: Stainless steel.

2.7 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand:

1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.

a. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

3. Hardware: Galvanized steel or polycarbonate.

4. Accessories: Protection pads.

C. Low-Profile, Single-Base, Single-Pipe Stand:

1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.

2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.

a. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.

4. Horizontal Member: Adjustable horizontal, galvanized-steel pipe support channels.

5. Pipe Supports: Roller.

6. Hardware: Galvanized steel.

7. Accessories: Protection pads.

8. Height: 12 inches above roof.

D. High-Profile, Single-Base, Single-Pipe Stand:

1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

2. Base: Single vulcanized rubber or molded polypropylene.

a. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.

4. Horizontal Member: One adjustable-height, galvanized--steel, pipe-support slotted channel or plate.

5. Pipe Supports: Roller.

6. Hardware: Galvanized steel.

7. Accessories: Protection pads, 1/2-inch, continuous-thread, galvanized-steel rod.

8. Height: 36 inches above roof.

E. High-Profile, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

2. Bases: Two or more; vulcanized rubber.

a. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

3. Vertical Members: Two or more, galvanized-steel channels.

4. Horizontal Members: One or more, adjustable-height, galvanized-steel pipe support.

5. Pipe Supports: Roller.

6. Hardware: Galvanized steel.

7. Accessories: Protection pads, 1/2-inch, continuous-thread rod.

8. Height: 36 inches above roof.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.8 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.10 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, 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 APPLICATION

A. Comply with requirements for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Meta lFraming 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.

2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

G. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

H. Install hangers and supports complete with necessary attachments, 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 that 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 to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.

b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.

c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

    b. NPS 4: 12 inches long and 0.06 inch thick.

    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 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 bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

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/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 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. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use stainless-steel pipe hangers and and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal hanger-shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.

11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.

12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.

18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.

20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.

    b. Medium (MSS Type 32): 1500 lb.

    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.

4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.

    b. Vertical (MSS Type 55): Mounted vertically.

    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Pipe labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.2 ACTION 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-numbering scheme.

E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

F. Build American Design Submittals:

1. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Brady Corporation.

   b. Marking Services, Inc.

   c. Seton Identification Products.

2. Material and Thickness: Brass, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.

3. Letter and Background Color: As indicated for specific application under Part 3.

4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

6. Fasteners: Stainless steel rivets or self-tapping screws.

7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Brady Corporation.

   b. Marking Services, Inc.

   c. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.

3. Letter and Background Color: As indicated for specific application under Part 3.

4. Maximum Temperature: Able to withstand temperatures of 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 of 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.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.

2. Marking Sevices Inc.

3. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Maximum Temperature: Able to withstand temperatures of 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 of 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 WARNING TAPE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Marking Sevices Inc.
3. Seton Identification Products.

B. Material: Vinyl.

C. Minimum Thickness: 0.005 inch.

D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.

E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.

F. Maximum Temperature: 160 deg F.

G. Minimum Width: 2 inches.

2.4 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Marking Sevices Inc.
3. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.5 STENCILS

A. Stencils for Piping:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brimar Industries, Inc.

b. Craftmark Pipe Markers.

c. Marking Sevices Inc.

2. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

3. Stencil Material: Aluminum, brass, or fiberboard.

4. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

5. Letter and Background Color: As indicated for specific application under Part 3.

2.6 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.

2. Marking Sevices Inc.

3. Seton Identification Products.

B. Description: 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, with predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire link chain.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. 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. Include valve-tag schedule in operation and maintenance data.

2.7 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.

2. Marking Sevices Inc.

3. Seton Identification Products.

B. Description: 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. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of plumbing equipment.

B. Sign and Label Colors.

1. White letters on an ANSI Z535.1 safety-green background.

C. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF WARNING TAPE

A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.

B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.

C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

C. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction 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.

D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within 3 ft. of 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. Within 3 ft. of equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 ft. along each run. Reduce intervals to 25 ft. in areas of congested piping and equipment.

E. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.

F. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

G. Pipe-Label Color Schedule: Color per ANSI/ASME A13.1 unless noted otherwise.

1. Low-Pressure Compressed-Air Piping:

   a. Background: Safety blue.

   b. Letter Colors: White.

2. High-Pressure Compressed-Air Piping:

   a. Background: Safety blue.

   b. Letter Colors: White.

3. Natural Gas Piping:

   a. Background: Yellow.

   b. Letter Colors: Black.

4. Liquefied Propane Gas Piping:

   a. Background: Yellow.

   b. Letter Colors: Black.

5. Vacuum Piping:

   a. Background: Safety blue.

   b. Letter Colors: White.

6. Domestic Water Piping:

   a. Background: Safety green.

   b. Letter Colors: White.

7. Non-potable Water:

   a. Background: Yellow.

   b. Letter Colors: Black.

8. Reagent Water Piping:

    a. Background: Safety blue.

    b. Letter Colors: White.

9. Deionized Water Piping:

    a. Background: Safety blue.

    b. Letter Colors: White.

10. Distilled Water Piping:

    a. Background: Safety blue.

    b. Letter Colors: White.

11. Reverse Osmosis Water Piping:

    a. Background: Safety blue.

    b. Letter Colors: White.

12. Sanitary Waste and Storm Drainage Piping:

    a. Background: Safety black.

    b. Letter Colors: White.

3.6 INSTALLATION OF VALVE TAGS

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 in the operating and maintenance manual.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

    a. Domestic Cold Water: 1-1/2 inches, round.

    b. Domestic Hot Water: 1-1/2 inches, round.

    c. Domestic Hot-Water Return: 1-1/2 inches, round.

    d. Low-Pressure Compressed Air: 1-1/2 inches, round.

    e. High-Pressure Compressed Air: 1-1/2 inches, round.

f. Nonpotable Water: 1-1/2 inches, round.

g. Reagent Water Piping: 1-1/2 inches, round.

h. Deionized Water Piping: 1-1/2 inches, round.

i. Distilled Water Piping: 1-1/2 inches, round.

j. Reverse Osmosis Water Piping: 1-1/2 inches, round.

2. Valve-Tag Colors:

a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.7 INSTALLATION OF WARNING TAGS

A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.

B. Attach warning tags, with proper message, to equipment and other items where required.

END OF SECTION 220553

SECTION 220593 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. TAB of domestic water system.
2. TAB of plumbing equipment:
    a. Domestic water booster pumps.
    b. Domestic hot-water in-line circulation pumps.
    c. General-duty air compressors.
    d. Sanitary sewage pumps.
    e. Drainage pumps.
    f. Laboratory air compressors.
    g. Laboratory vacuum pumps.
3. Pipe-leakage test verification.
4. Testing, adjusting, and balancing of existing plumbing systems and equipment.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. System Readiness Checklists: Within 60 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.

2. Serial number.

3. Application.

4. Dates of use.

5. Dates of calibration.

1.4 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.

2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. TAB Specialists Qualifications, Certified by NEBB or TABB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.

2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.

E. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."

F. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.5 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine approved submittals for plumbing systems and equipment.

D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.

E. Examine equipment performance data, including pump curves.

1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.

F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

J. Examine system pumps to ensure absence of entrained air in the suction piping.

K. Examine operating safety interlocks and controls on plumbing equipment.

L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.

2. Strategies and step-by-step procedures for balancing the systems.

3. Instrumentation to be used.

4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Domestic Water System:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.

b. Water heaters are installed and functioning.

c. Piping is complete and all points of outlet are installed.

d. Water treatment is complete.

e. Systems are flushed, filled, and air purged.

f. Strainers are clean.

g. Control valves are functioning in accordance with the sequence of operation.

h. Shutoff and balance valves are 100 percent open.

i. Hot-water circulating pumps are operational and proper rotation is verified.

j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.

k. Variable-frequency controllers' startup is complete and safeties are verified.

l. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.

2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish.

C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.

2. Domestic water in-line pumps.

3. Domestic water heaters.

3.5 PROCEDURES FOR DOMESTIC WATER SYSTEMS

A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:

1. Check expansion tank for proper setting.

2. Check water heater for proper discharge temperature setting.

3. Check remotest point of outlet for adequate pressure.

4. Check flow-control valves for proper position.

5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.

6. Verify that motor controllers are equipped with properly sized thermal protection.

7. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

G. Check settings and operation of each safety valve. Record settings.

3.6 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

A. Balance system with manual or automatic balancing valves by setting at design flow.

1. Measure flow in main and branch pipes.

2. Adjust main and branch balance valves for design flow.

3. Re-measure each main and branch after all have been adjusted.

B. Adjust pump to deliver total design flow.

1. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.

b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.

c. Convert pressure to head and correct for differences in gauge heights.

d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.

2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

3. Mark final settings and verify that all memory stops have been set.

4. Verify final system conditions as follows:

a. Re-measure and confirm that total flow is within design.

b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.

c. Mark final settings.

3.7 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.8 PROCEDURES FOR WATER HEATERS

A. Electric Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h (kW) of heating output.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

B. Gas- and Oil-Fired Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and Record relief valve(s) pressure setting.

5. Capacity: Calculate in Btu/h (kW) of heating output.

6. Fuel Consumption: If fuel supply is equipped with flow meter, measure and record consumption.

7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

8. Fan, motor, and motor controller operating data.

3.9 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record flows, temperatures, and pressures of each piece of equipment. Compare the values to design or nameplate information, where information is available.

2. Measure motor voltage and amperage. Compare the values to motor nameplate information.

3. Check the condition of filters.

4. Check bearings and other lubricated parts for proper lubrication.

5. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:

1. New filters are installed.

2. Bearings and other parts are properly lubricated.

3. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated system flows of the renovated work to the measured flows, and determine the new pump speed.

2. Verify that the indicated system flows of the renovated work result in velocities and pump speeds that are within the acceptable limits defined by equipment manufacturer.

3. If calculations increase or decrease the system flow rates by more than [**5**] <**Insert number**> percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is [**5**] <**Insert number**> percent or less, equipment adjustments are not required.

3.10 TOLERANCES

A. Set plumbing system's flow rates within the following tolerances:

1. Domestic Water Flow Rate: Plus or minus 10 percent. If design value is less than 10 gpm (0.63 L/s), within 10 percent.

2. Compressed-Air Flow Rate: Plus or minus 10 percent. If design value is less than 10 gpm (0.63 L/s), within 10 percent.

3. Vacuum Flow Rate: Plus or minus 10 percent.

3.11 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.12 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

2. Include a list of instruments used for procedures, along with proof of calibration.

3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.

2. Manufacturers' test data.

3. Field test reports prepared by system and equipment installers.

4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.

2. Name and address of the TAB specialist.

3. Project name.

4. Project location.

5. Architect's name and address.

6. Engineer's name and address.

7. Contractor's name and address.

8. Report date.

9. Signature of TAB supervisor who certifies the report.

10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents, including the following:

    a. Indicated versus final performance.

    b. Notable characteristics of systems.

    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.

13. Notes to explain why certain final data in the body of reports vary from indicated values.

14. Test conditions for pump performance forms, including the following:

    a. Variable-frequency controller settings for variable-flow hydronic systems.

    b. Settings for pressure controller(s).

    c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:

1. Flow rates.

2. Pipe and valve sizes and locations.

3. Balancing stations.

4. Position of balancing devices.

E. Gas- and Oil-Fired Water Heaters Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:
    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Fuel type in input data.
    g. Output capacity in Btu/h (kW).
    h. Ignition type.
    i. Burner-control types.
    j. Motor horsepower and speed.
    k. Motor volts, phase, and hertz.
    l. Motor full-load amperage and service factor.
    m. Sheave make, size in inches (mm), and bore.
    n. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
2. Test Data (Indicated and Actual Values):
    a. Total airflow rate in cfm (L/s).
    b. Entering-water temperature in deg F (deg C).
    c. Leaving-water temperature in deg F (deg C).
    d. Low-fire fuel input in Btu/h (kW).
    e. High-fire fuel input in Btu/h (kW).
    f. High-temperature-limit setting in deg F (deg C).
    g. Operating set point in Btu/h (kW).
    h. Heating value of fuel in Btu/h (kW).

F. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:
    a. System identification.

b. Location.

c. Model number and unit size.

d. Manufacturer's serial number.

e. Output capacity in Btu/h (kW).

f. Number of stages.

g. Connected volts, phase, and hertz.

h. Rated amperage.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h (kW).

b. Entering-water temperature in deg F (deg C).

c. Leaving-water temperature in deg F (deg C).

d. High-temperature-limit setting in deg F (deg C).

e. Operating set point in deg F (deg C).

f. Voltage at each connection.

g. Amperage for each phase.

G. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:

1. Unit Data:

a. Unit identification.

b. Location.

c. Service.

d. Make and size.

e. Model number and serial number.

f. Water flow rate in gpm (L/s).

g. Water-pressure differential in feet of head or psig (kPa).

h. Required net positive suction head in feet of head or psig (kPa).

i. Pump speed.

j. Impeller diameter in inches (mm).

k. Motor make and frame size.

l. Motor horsepower and rpm.

m. Voltage at each connection.

n. Amperage for each phase.

o. Full-load amperage and service factor.

p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig (kPa).

b. Pump shutoff pressure in feet of head or psig (kPa).

c. Actual impeller size in inches (mm).

d. Full-open flow rate in gpm (L/s).

e. Full-open pressure in feet of head or psig (kPa).

f. Final discharge pressure in feet of head or psig (kPa).

g. Final suction pressure in feet of head or psig (kPa).

h. Final total pressure in feet of head or psig (kPa).

i. Final water flow rate in gpm (L/s).

j. Voltage at each connection.

k. Amperage for each phase.

H. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.

b. Serial number.

c. Application.

d. Dates of use.

e. Dates of calibration.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 220593

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Roof drains and rainwater leaders.
5. Supplies and drains for handicap-accessible lavatories and sinks.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Sustainable Design Submittals:

1. Product Data: For adhesives, mastics, and sealants, indicating VOC content.
2. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.

C. Build American Design Submittals:

1. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.4 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. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 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 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. All Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Aeroflex USA, Inc.

b. Armacell LLC.

G. Mineral-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Knauf Insulation.

c. Owens Corning.

2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ-SSL.

3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.

4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

A. Materials are 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: Solvent-based adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Aeroflex USA, Inc.

b. Armacell LLC.

1. Adhesive: As recommended by flexible elastomeric and polyolefin manufacturer and with a VOC content of 80 g/L or less.

2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

3. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.

4. Wet Flash Point: Below 0 deg F.

5. Service Temperature Range: 40 to 200 deg F.

6. Color: Black.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.

b. Foster Brand; H. B. Fuller Construction Products.

2. Adhesive: As recommended by mineral fiber manufacturer and with a VOC content of 80 g/L or less.

3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of

Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.

b. Foster Brand; H. B. Fuller Construction Products.

2. Adhesives shall have a VOC content of 80 g/L or less.

3. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Speedline Corporation.

2. Adhesive: As recommended by Adhesive - PVC Jacket manufacturer and with a VOC content of 50 g/L or less.

3. Adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.4 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.

b. Foster Brand; H. B. Fuller Construction Products.

2. Permanently flexible, elastomeric sealant.

3. Service Temperature Range: Minus 58 to plus 176 deg F.

4. Color: White or gray.

5. Sealant shall have a VOC content of 420 g/L or less.

6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.

b. Foster Brand; H. B. Fuller Construction Products.

2. Fire- and water-resistant, flexible, elastomeric sealant.

3. Service Temperature Range: Minus 40 to plus 250 deg F.

4. Color: Aluminum.

5. Sealant shall have a VOC content of 420 g/L or less.

6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.

2. Fire- and water-resistant, flexible, elastomeric sealant.

3. Service Temperature Range: Minus 40 to plus 250 deg F.

4. Color: White.

5. Sealant shall have a VOC content of 420 g/L or less.

6. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.

5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Johns Manville; a Berkshire Hathaway company.
   b. Speedline Corporation

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White.

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Speedline Corporation

2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.

b. Finish and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.

2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.

3) Tee covers.

4) Flange and union covers.

5) End caps.

6) Beveled collars.

7) Valve covers.

8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless Steel Jacket: ASTM A240/A240M.

a. Sheet and roll stock ready for shop or field sizing.

b. Material, finish, and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.

2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.

3) Tee covers.

4) Flange and union covers.

5) End caps.

6) Beveled collars.

7) Valve covers.

8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket with five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.
b. Foster Brand; H. B. Fuller.
c. Ideal Tape Co., Inc., an American Biltrite Company.

2. Permeance: 0.00 perm as tested in accordance with ASTM F1249.

3. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.

4. Aluminum Finish: Smooth.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.
b. Foster Brand; H. B. Fuller.
c. Ideal Tape Co., Inc., an American Biltrite Company.

B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.
b. Foster Brand; H. B. Fuller.
c. Ideal Tape Co., Inc., an American Biltrite Company.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.
b. Foster Brand; H. B. Fuller.
c. Ideal Tape Co., Inc., an American Biltrite Company.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.
b. Foster Brand; H. B. Fuller.
c. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 3 inches.

3. Thickness: 11.5 mils.

4. Adhesion: 90 ounces force/inch in width.

5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Building and Construction.
    b. Foster Brand; H. B. Fuller.
    c. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 3 inches.

3. Thickness: 6.5 mils.

4. Adhesion: 90 ounces force/inch in width.

5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch in width.

7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Building and Construction.
    b. Foster Brand; H. B. Fuller.
    c. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 2 inches.

3. Thickness: 6 mils.

4. Adhesion: 64 ounces force/inch in width.

5. Elongation: 500 percent.

6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Building and Construction.
    b. Foster Brand; H. B. Fuller.
    c. Ideal Tape Co., Inc., an American Biltrite Company.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.
b. Foster Brand; H. B. Fuller.
c. Ideal Tape Co., Inc., an American Biltrite Company.

2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with or closed seal.

3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, galvanized steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.
b. Foster Brand; H. B. Fuller.
c. Ideal Tape Co., Inc., an American Biltrite Company.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Buckaroos, Inc.
b. MVG Molded Products.
c. McGuire Manufacturing.
d. Plumberex Specialty Products, Inc.
e. ProFlo; a Ferguson Enterprises, Inc. brand.
f. Truebro; IPS Corporation.
g. Zurn; Zurn Elkay.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures,:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ProFlo; a Ferguson Enterprises, Inc. brand.
    b. Truebro; IPS Corporation.
    c. Zurn; Zurn Elkay.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 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. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

2. Carbon Steel: Coat carbon steel operating at a service temperature of 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 tradesman 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 piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) 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 storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents, unless otherwise approved by the engineer-of-record.

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 attached to structure with vapor-barrier mastic.

3. Install insert materials and 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, but not to the extent of creating wrinkles or areas of compression in the insulation.

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, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation.

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 in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.

2. Testing agency labels and stamps.

3. Nameplates and data plates.

4. Cleanouts.

3.4 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.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 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 below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is 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 that 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 that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 2 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, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.

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.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation conforms 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 that of adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 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.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.

4. For insulation with jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated 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 cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.

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 prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of cellular-glass insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of 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 sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.

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 prefabricated valve covers manufactured of same material as that of pipe insulation when available.

2. When prefabricated 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 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.

4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated 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 glass-fiber or mineral-wool 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 prefabricated sections of same material as that of straight segments of pipe insulation when available.

2. When prefabricated 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 prefabricated sections of same material as that of straight segments of pipe insulation when available.

2. When prefabricated sections are not available, install fabricated 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 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless steel bands at 12-inch intervals, and tighten bands without deforming insulation materials.

2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.

4. For insulation with jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive, or via self-seal mechanism 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 polyolefin sheet insulation of same thickness as that of 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 polyolefin 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 cut sections of polyolefin pipe and sheet insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

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.

3.11 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.

2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.

3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.

2. Install lap or joint strips with same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.12 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

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.

3.13 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

F. All insulation applications will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.14 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.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.

b. Flexible Elastomeric: 1 inch thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

e. Phenolic: 1 inch thick.

f. Polyolefin: 1 inch thick.

2. NPS 1-1/4 and Larger: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.

b. Flexible Elastomeric: 1 inch thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

e. Phenolic: 1 inch thick.

f. Polyolefin: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.

b. Flexible Elastomeric: 3/4 inch thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

e. Phenolic: 1 inch thick.

f. Polyolefin: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.

b. Flexible Elastomeric: 1 inch thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

e. Phenolic: 1 inch thick.

f. Polyolefin: 1 inch thick.

C. Domestic Chilled Water (Potable):

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.

b. Flexible Elastomeric: 1 inch thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

e. Phenolic: 1 inch thick.

f. Polyolefin: 1 inch thick.

D. Stormwater and Overflow:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.

b. Flexible Elastomeric: 1 inch thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

e. Phenolic: 1 inch thick.

f. Polyolefin: 1 inch thick.

E. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.

b. Flexible Elastomeric: 1 inch thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

e. Phenolic: 1 inch thick.

f. Polyolefin: 1 inch thick.

F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation is one of the following:

    a. Flexible Elastomeric: 1 inch thick.

    b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

    c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

    d. Polyolefin: 1 inch thick.

G. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation is one of the following:

    a. Cellular Glass: 2 inches thick.

    b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

    c. Mineral Wool, Preformed Pipe Insulation, Type II: 1-1/2 inches thick.

    d. Phenolic: 1-1/2 inches thick.

H. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation is one of the following:

    a. Cellular Glass: 1-1/2 inches thick.

    b. Flexible Elastomeric: 1 inch thick.

    c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

    d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

    e. Phenolic: 1 inch thick.
    f. Polyolefin: 1 inch thick.

I. Hot Service Drains:

1. All Pipe Sizes: Insulation is one of the following:

    a. Cellular Glass: 1-1/2 inches thick.

    b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

    c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

J. Hot Service Vents:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.

b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 2 inches thick.

b. Flexible Elastomeric: 2 inches thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.

e. Phenolic: 2 inches thick.

f. Polyolefin: 2 inches thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 2 inches thick.

b. Flexible Elastomeric: 2 inches thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.

e. Phenolic: 2 inches thick.

f. Polyolefin: 2 inches thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 2 inches thick.

b. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

c. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.

d. Phenolic: 2 inches thick.

D. Hot Service Drains:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.

b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

E. Hot Service Vents:

1. All Pipe Sizes: Insulation is one of the following:

a. Cellular Glass: 1-1/2 inches thick.

b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.

3.17 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

A. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.

B. Chilled Water, All Sizes: Cellular glass, 2 inches thick.

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

2. PVC, Color-Coded by System: 30 mils thick.

3. Aluminum, Smooth: 0.024 inch thick.

4. Painted Aluminum, Smooth: 0.024 inch thick.

5. Stainless Steel, Type 304 or Type 316, Corrugated: 0.024 inch thick.

3.19 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.

2. PVC: 30 mils thick.

3. Aluminum, Smooth: 0.024 inch thick.

4. Painted Aluminum, Smooth: 0.024 inch thick.

5. Stainless Steel, Type 304 or Type 316, Corrugated: 0.024 inch thick.

D. Piping, Exposed:

1. PVC: 30 mils thick.

2. Painted Aluminum, Smooth: 0.024 inch thick.

3. Stainless Steel, Type 304 or Type 316, Corrugated: 0.024 inch thick.

3.20 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

SECTION 220800 - COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes Cx process requirements for the following plumbing systems, assemblies, and equipment:

1. Domestic hot- and cold-water piping.
2. Sanitary waste and vent piping.
3. Plumbing pumps.
4. Plumbing equipment.

B. Related Requirements:

1. For construction checklists, comply with requirements in various Division 22 Sections specifying plumbing systems, system components, equipment, and products.

1.2 DEFINITIONS

A. IAPMO: International Association of Plumbing and Mechanical Officials.

B. IgCC: International Green Construction Code.

C. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.3 INFORMATIONAL SUBMITTALS

A. Construction Checklists:

B. Test Equipment and Instruments: For all test equipment and instruments to be used in conducting Cx tests by Contractor, provide the following:

1. Equipment/instrument identification number.

2. Planned Cx application or use.

3. Manufacturer, make, model, and serial number.

4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.

5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:

a. Instrument or tool identification number.

b. Equipment schedule designation of equipment for which the instrument or tool is required.

c. Manufacturer, make, model, and serial number.

d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

1.4 QUALITY ASSURANCE

A. Testing Equipment and Instrumentation Quality and Calibration:

1. Capable of testing and measuring performance within the specified acceptance criteria.

2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.

3. Be maintained in good repair and operating condition throughout duration of use on Project.

4. Be recalibrated/repaired if dropped or damaged in any way since last calibrated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 Cx PROCESS

A. Perform commissioning process for plumbing systems in accordance with:

1. ASHRAE 202.
2. Commissioning standards acceptable to the authority having jurisdiction.

3.2 CONSTRUCTION CHECKLISTS

A. Preliminary detailed construction checklists are to be prepared under Section 019113 "General Commissioning Requirements" for each plumbing system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in ASHRAE 202. IAPMO's "Green Plumbing and Mechanical Code Supplement." Contractor performs the following:

1. Review plumbing preliminary construction checklists and provide written comments on Construction Checklist items where appropriate.

2. Return preliminary Construction Checklist with review comments within 10 days of receipt.

3. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."

4. Use only construction checklists marked "Approved for Use, (date)." Mark construction checklists in the appropriate place, as indicated Project events are completed, and provide pertinent details and other information.

B. Additional Systems Required to Be Commissioned:

1. Facility water-distribution piping, including the following:

   a. Domestic water piping, fittings, and specialties outside the building.

   b. Pumps, motors, accessories, and controls.

   c. Outdoor water-storage tanks.

   d. Sleeves and sleeve seals.

   e. Meters and gauges.

   f. General-duty and specialty valves.

   g. Hangers and supports.

   h. Heat tracing.

   i. Vibration isolation and seismic restraints.

2. Domestic water piping, including the following:

   a. Domestic cold- and hot-water piping, fittings, and specialties inside the building.

   b. Pumps, motors, accessories, and controls.

   c. Sleeves and sleeve seals.

   d. Indoor water-storage tanks.

   e. Meters and gauges.

   f. General-duty and specialty valves.

   g. Hangers and supports.

   h. Heat tracing.

   i. Vibration isolation and seismic restraints.

3. Sanitary waste and vent piping, including the following:

   a. Gravity and forced-main sewerage piping, fittings, and specialties.

   b. Sanitary waste interceptors.

   c. Pumps, motors, accessories, and controls.

d. Drains.

e. Sleeves and sleeve seals.

f. Meters and gauges.

g. General-duty and specialty valves.

h. Hangers and supports.

i. Heat tracing.

j. Vibration isolation and seismic restraints.

4. Plumbing fixtures, including the following:

a. Water closets, supports and connections, supplies, and flush valves.

b. Urinals, supports and connections, supplies, and flush valves.

c. Lavatories, supports, supplies, drain connections, and faucets.

d. Sinks, supports, supplies, drain connections, and faucets.

e. Tubs, drain connections, and faucets.

f. Showers, supplies, drain connections, and faucets.

g. Wash fountains, supplies, drain connections, and faucets.

h. Emergency plumbing fixtures, supplies, drain connections, and controls.

i. Drinking fountains, supplies, and drainage connections.

3.3 Cx TESTING PREPARATION

A. Certify that plumbing systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating in accordance with the Contract Documents and approved submittals.

B. Certify that plumbing system instrumentation and control systems have been completed and calibrated, point-to-point checkout has been successfully completed, and systems are operating in accordance with their design sequence of operation, Contract Documents, and approved submittals. Certify that all sensors are operating within specified accuracy and that all systems are set to and maintaining set points as required by the design documents.

C. Set systems, subsystems, and equipment into operating mode to be tested in accordance with approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

3.4 Cx TEST CONDITIONS

A. Perform tests using design conditions, whenever possible.

1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.

2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.

3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

B. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.

C. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.5 Cx TESTS COMMON TO PLUMBING SYSTEMS

A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.

B. Test systems, assemblies, subsystems, equipment, and components for operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response according to acceptance criteria.

C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.

D. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance test requirements specified in Division 22 Sections specifying plumbing systems and equipment.

E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:

1. Cx Construction Checklist verification tests.

2. Cx Construction Checklist verification test demonstrations.

3.6 CONSTRUCTION CHECKLIST EXAMPLES

1. Prerequisites: Acceptance of results of construction checklists for plumbing systems specified in the following Sections :

a. Section 221119 "Domestic Water Piping Specialties."

2. Test Scope:

    a. Monitored plumbing system water meters.

3. Test Purpose:

    a. Verify accuracy of reporting of monitored plumbing system water meters at other utility consumption management system.

4. Test Conditions:

    a. Plumbing system water meter recording systems operating in normal, automatic mode.

    b. Compare cumulative consumption data at plumbing system water meter recording systems with independent, calibrated, flow-measuring instrumentation under the following conditions:

        1) Low Flow: 1 percent of maximum design flow rate for a period of four hours.

        2) High Flow: 80 percent of maximum design flow rate for a period of 20 minutes.

    c. Activate monitored plumbing alarms, one at a time.

5. Acceptance Criteria:

    a. Cumulative flow reported for low-flow condition is within 5 percent flow recorded by calibrated flow-measuring instrumentation.

    b. Cumulative flow reported for high-flow condition is within 1 percent flow recorded by calibrated flow-measuring instrumentation.

3.7 Cx TESTS FOR COMPRESSED-AIR SYSTEMS

END OF SECTION 220800

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Ductile-iron pipe and fittings.
3. CPVC piping.
4. PEX tube and fittings.
5. Piping joining materials.
6. Encasement for piping.
7. Transition fittings.
8. Dielectric fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. System purging and disinfecting activities report.

C. Field quality-control reports.

D. Build American Design Submittals:

1. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

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 in accordance with requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.

2. Do not interrupt water service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 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 are to comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on plastic piping and components.

2.3 COPPER TUBE AND FITTINGS - DOMESTIC WATER

A. Drawn-Temper Copper Tube: ASTM B88, Type K and ASTM B88, Type L.

B. Annealed-Temper Copper Tube: ASTM B88, Type K.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.

D. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends. Do not use solder joints on pipe sizes greater than NPS 4.

E. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.

F. Pressure-Seal-Joint Fittings, Copper or Bronze - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mueller Streamline Co.; a company of Mueller Industries.

b. NIBCO INC.

c. Viega LLC.

2. Source Limitations: Obtain pressure-seal-joint fittings, copper or bronze, from single manufacturer.

3. Housing: Copper.

4. O-Rings and Pipe Stops: EPDM.

5. Tools: Manufacturer's special tools.

6. Minimum 200 psig working-pressure rating at 250 deg F.

2.4 DUCTILE-IRON PIPE AND FITTINGS - DOMESTIC WATER

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.

2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.

2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51.

2. Push-on joint bell and plain spigot end unless grooved or flanged ends are indicated.

E. Standard-Pattern, Push-on Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.

2. Gaskets: AWWA C111/A21.11, rubber.

F. Compact-Pattern, Push-on Joint Fittings:

1. AWWA C153/A21.53, ductile iron.

2. Gaskets: AWWA C111/A21.11, rubber.

G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

H. Appurtenances for Grooved-End, Ductile-Iron Pipe - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Shurjoint; a part of Aalberts Integrated Piping Systems.

b. Smith-Cooper International.

c. Victaulic Company.

2. Source Limitations: Obtain appurtenances for grooved-end, ductile-iron pipe from single manufacturer.

3. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A47/A47M, malleable-iron castings or ASTM A536, ductile-iron castings with dimensions that match pipe.

4. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:

a. AWWA C606 for ductile-iron-pipe dimensions.

b. Ferrous housing sections.

c. EPDM-rubber gaskets suitable for hot and cold water.

d. Bolts and nuts.

e. Minimum Pressure Rating:

1) NPS 14 to NPS 18 (DN 350 to DN 450): 250 psig.

2) NPS 20 to NPS 46 (DN 500 to DN 900): 150 psig.

2.5 CPVC PIPING - DOMESTIC WATER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Charlotte Pipe and Foundry Company.

2. IPEX USA LLC.

3. Spears Manufacturing Company.

B. Source Limitations: Obtain CPVC piping from single manufacturer.

C. CPVC Pipe: ASTM F441/F441M, with wall thickness as indicated in "Piping Applications" Article.

1. CPVC Socket Fittings: ASTM F438 for Schedule 40 and ASTM F439 for Schedule 80.

2. CPVC Threaded Fittings: ASTM F437, Schedule 80.

D. CPVC Piping System: ASTM D2846/D2846M, SDR 11, pipe and socket fittings.

E. CPVC Tubing System: ASTM D2846/D2846M, SDR 11, tube and socket fittings.

2.6 PEX TUBE AND FITTINGS - DOMESTIC WATER

A. PEX Tube:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Uponor.

b. Viega LLC.

c. Zurn Industries, LLC.

2. Source Limitations: Obtain PEX tube from single manufacturer.

3. Tube Material: Cross-linked plyethylene (PEX) plastic manufactured via Silane method in accordance with ASTM F876 and ASTM F877.

4. Tubing shall be non-barrier type.

5. Tubing shall have a pressure and temperature rating of 160 PSI at 73°F, 100 PSI at 180°F and 80 PSI at 200°F.

6. Tubing to be used for hot water recirculation piping shall have PEX 5006 chlorine designation.

7. Tubing shall be plenum rated in accordance with ASTM E84.

8. Tubing shall have a 25 year, non-prorated warranty.

B. PEX Tube Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Uponor.

b. Zurn Industries, LLC.

Source Limitations: Obtain PEX tube fittings from single manufacturer.

2. Fittings: ASTM F1960, cold expansion fittings and reinforcing rings.

3. Fittings shall be lead free.

4. Expansion system: Use manufacturer's specific tooling and follow all manufacturer's written instructions.

C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F876; with plastic or corrosion-resistant-metal valve for each outlet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Uponor.

b. Zurn Industries, LLC.

2.7 PIPING JOINING MATERIALS - DOMESTIC WATER

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 B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.

G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.8 ENCASEMENT FOR PIPING

A. Standard: ASTM A674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

2.9 TRANSITION FITTINGS - DOMESTIC WATER

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 Couplings - Domestic Water: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cascade Waterworks Mfg. Co.

b. Dresser Pipeline Solutions.

c. JCM Industries, Inc.

d. Smith-Blair, a Xylem brand.

e. Viking Johnson.

2. Source Limitations: Obtain sleeve-type transition couplings from single manufacturer.

D. Plastic-to-Metal Transition Fittings - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.

b. Sioux Chief Manufacturing Company, Inc.

c. Spears Manufacturing Company.

d. Uponor.

e. Aquatherm.

2. Source Limitations: Obtain plastic-to-metal transition fittings from single source.

3. Description:

a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.

b. One end with threaded brass insert and one solvent-cement-socket end.

2.10 DIELECTRIC FITTINGS - DOMESTIC WATER

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Central Plastics Company.
    b. Jomar International.
    c. Matco-Norca.
    d. McDonald, A. Y. Mfg. Co.
    e. Watts; a division of Watts Water Technologies, Inc.
    f. Wilkins; a Zurn company.
2. Source Limitations: Obtain dielectric unions from single manufacturer.
3. Standard: ASSE 1079.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Central Plastics Company.
    b. Jomar International.
    c. Matco-Norca.
    d. McDonald, A. Y. Mfg. Co.
    e. Watts; a division of Watts Water Technologies, Inc.
    f. Wilkins; a Zurn company.
2. Source Limitations: Obtain dielectric flanges from single manufacturer.
3. Standard: ASSE 1079.
4. Factory-fabricated, bolted, companion-flange assembly.
5. Pressure Rating: 125 psig minimum at 180 deg F.
6. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Advance Products & Systems, LLC.

    b. CALPICO, Inc.

    c. GPT; a division of EnPRO Industries.

2. Source Limitations: Obtain dielectric-flange insulating kits from single manufacturer.

3. Nonconducting materials for field assembly of companion flanges.

4. Pressure Rating: 150 psig.

5. Gasket: Phenolic, Temperature Rating: 225 deg F.

6. Bolt Sleeves: Phenolic or polyethylene.

7. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples - Domestic Water:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anvil; an ASC Engineered Solution.

    b. Apollo Valves; a part of Aalberts Integrated Piping Systems.

    c. Sioux Chief Manufacturing Company, Inc.

    d. Victaulic Company.

2. Source Limitations: Obtain dielectric nipples from single manufacturer.

3. Standard: IAPMO PS 66.

4. Electroplated steel nipple complying with ASTM F1545.

5. Pressure Rating and Temperature: 300 psig at 225 deg F.

6. End Connections: Male threaded or grooved.

7. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 INSTALLATION OF PIPING

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 in accordance with CDA's "Copper Tube Handbook."

C. 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 and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

D. Install shutoff valve immediately upstream of each dielectric fitting.

E. Install ductile-iron piping under building slab with restrained joints in accordance with AWWA C600 and AWWA M41.

F. Install underground copper tube and ductile-iron pipe in PE encasement in accordance with ASTM A674 or AWWA C105/A21.5.

G. Install valves in accordance with Section 220523 "General-Duty Valves for Plumbing Piping."

H. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

I. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

J. Rough-in domestic water piping for water-meter installation in accordance with utility company's requirements.

K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

N. Install piping to permit valve servicing.

O. Contractor shall provide access panels for all concealed equipment, valves, strainers, control devices, cleanouts, traps, and other items and devices requiring maintenance or access for service, adjustment, balancing or manual operation.

P. 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.

Q. Install piping free of sags and bends.

R. Install fittings for changes in direction and branch connections.

S. Install PEX tube with loop at each change of direction of more than 90 degrees.

T. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

U. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220500 "Common Work Results for Plumbing."

V. Install thermostats in hot-water circulation piping.

W. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220500 "Common Work Results for Plumbing."

X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "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 in accordance with 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. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."

E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

F. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints in accordance with 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.

G. 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 in accordance with ASME B31.9.

H. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.

2. CPVC Piping: Join in accordance with ASTM D2846/D2846M.

I. Joints for PEX Tubing, ASTM: Join in accordance with ASTM F1960 for cold expansion fittings and reinforcing rings.

J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 INSTALLATION OF TRANSITION FITTINGS

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 unions.

3.5 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices.

B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "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. Install hangers for copper tube and ductile iron pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Install vinyl-coated hangers for CPVC pipe, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Install vinyl-coated hangers for PEX tube, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support horizontal piping within 12 inches of each fitting.

G. Support vertical runs of pipe and tubing at base and at each floor level.

H. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

I. 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.

J. Install supports for vertical copper tubing every 10 feet.

K. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

L. Support vertical runs of PEX tube to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.

2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 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 in accordance with 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.

3.10 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 FIELD QUALITY CONTROL

A. 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 installation 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 1.5 times the 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.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller is to be the following:

1. Annealed-temper copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

2. Copper pressure-seal fittings are not permitted.

D. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 4 to NPS 12 is to be the following:

1. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern, mechanical-joint fittings; and mechanical joints.

E. Under-building-slab, domestic water piping, NPS 2 and smaller is to be the following:

1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

F. Aboveground domestic water piping, NPS 6 and smaller is to be the following:

1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

2. Drawn-temper copper tube, ASTM B88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
4. PEX tube, NPS 1 and smaller.

a. Fittings for PEX tube:

1) ASTM F1960, cold expansion fittings and reinforcing rings.

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 valve for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.

4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Solenoid valves for water.
5. Balancing valves.
6. Temperature-actuated, water mixing valves.
7. Strainers.
8. Outlet boxes.
9. Drain valves.
10. Water-hammer arresters.
11. Trap-seal primer systems.
12. Flexible connectors.
13. Water meters.
14. Air vents.

B. Related Requirements:

1. Section 220500 "Common Work Results for Plumbing."

C. Build American Design Submittals:

1. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

1.2 DEFINITIONS

A. AMI: Advanced Metering Infrastructure.

B. AMR: Automatic Meter Reading.

C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Test and inspection reports.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.

b. Cash Acme Plumbing Products; an RWC brand.

c. FEBCO; A WATTS Brand.

d. WATTS; A Watts Water Technologies Company.

e. Zurn Industries, LLC.

2. Standard: ASSE 1001.

3. Size: NPS 1/4 to NPS 3, as required to match connected piping.

4. Body: Bronze.

5. Inlet and Outlet Connections: Threaded.

6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.

b. Cash Acme Plumbing Products; an RWC brand.

c. Champion-Arrowhead.

d. MIFAB, Inc.

e. WATTS; A Watts Water Technologies Company.

f. Woodford Manufacturing Company.

g. Zurn Industries, LLC.

h. Jay R. Smith Mfg Co; a division of Morris Group International.

2. Standard: ASSE 1011.

3. Body: Bronze, nonremovable, with manual drain.

4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.

5. Finish: Chrome or nickel plated.

C. Laboratory-Faucet Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves; a part of Aalberts Integrated Piping Systems.

    b. WATTS; A Watts Water Technologies Company.

    c. Zurn Industries, LLC.

2. Standard: ASSE 1035.

3. Size: NPS 1/4 or NPS 3/8 matching faucet size.

4. Body: Bronze.

5. End Connections: Threaded.

6. Finish: Chrome plated.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Ames Fire & Waterworks; A Watts Water Technologies Company.

    b. FEBCO; A WATTS Brand.

    c. WATTS; A Watts Water Technologies Company.

    d. Zurn Industries, LLC.

2. Standard: ASSE 1013.

3. Operation: Continuous-pressure applications.

4. Pressure Loss: 12 psig maximum, through middle third of flow range.

5. Body: Bronze for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.

6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

7. Configuration: Designed for horizontal, straight-through flow.

8. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.

b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check, and Double-Check Detector Backflow-Prevention Assemblies:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Ames Fire & Waterworks; A Watts Water Technologies Company.

b. FEBCO; A WATTS Brand.

c. WATTS; A Watts Water Technologies Company.

d. Zurn Industries, LLC.

2. Standard: ASSE 1015.

3. Operation: Continuous-pressure applications unless otherwise indicated.

4. Pressure Loss: 5 psig maximum, through middle third of flow range.

5. Body: Bronze for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.

6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

7. Configuration: Designed for horizontal, straight-through flow.

8. Accessories:

a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.

b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

c. Detector water meter where detector assemblies are indicated.

C. Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A.Y. McDonald Mfg. Co.

b. Cash Acme Plumbing Products; an RWC brand.

c. WATTS; A Watts Water Technologies Company.

d. Zurn Industries, LLC.

2. Standard: ASSE 1024.

3. Operation: Continuous-pressure applications.

4. Size: Same size as connected piping, see drawings for sizing.

5. Body: Bronze with union inlet.

D. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Fire & Waterworks; A Watts Water Technologies Company.

b. Apollo Valves; a part of Aalberts Integrated Piping Systems.

c. FEBCO; A WATTS Brand.

d. WATTS; A Watts Water Technologies Company.

e. Zurn Industries, LLC.

2. Description: Factory calibrated, with gauges, fittings, hoses, and carrying case with test-procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.

b. Caleffi North America.

c. Cash Acme Plumbing Products; an RWC brand.

d. WATTS; A Watts Water Technologies Company.

e. Zurn Industries, LLC.

2. Standard: ASSE 1003.

3. Pressure Rating: Initial working pressure of 150 psig.

4. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.

5. Valves for Booster Heater Water Supply: Include integral bypass.

6. End Connections: Threaded or solder for NPS 2 and smaller; flanged or solder for NPS 2-1/2 and NPS 3.

2.6 SOLENOID VALVES FOR WATER

A. Electrically Operated Valves: Comply with UL 429.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASCO Power Technologies, LP; Division of Emerson.

b. Magnatrol Valve Corporation.

c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.

2. Pilot operated.

3. Body: Brass or aluminum.

4. Seats and Disc: Nitrile rubber.

5. Springs and Valve Trim: Stainless steel.

6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.

7. NEMA ICS 6, Type 4, coil enclosure.

8. Normally closed.

9. Visual position indicator.

2.7 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bell & Gossett; a Xylem brand.

b. IMI Hydronic Engineering Inc.

c. Jomar Valve Company.

d. NIBCO INC.

e. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.

f. TACO Comfort Solutions.

g. WATTS; A Watts Water Technologies Company.

2. Type: Y-pattern globe valve with two readout ports and memory-setting indicator.

3. Body: Lead-free 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. Thermostatic Flow Control Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Caleffi North America.

b. ThermOmegaTech.

c. Acorn Controls; a Division of Morris Group International.

2. Flow Regulation: Plus or minus 5 percent over 95 percent of the working range.

3. Pressure Rating: 200 psig.

4. Size: NPS 2 or smaller.

5. Body: Stainless steel or lead-free brass.

6. Flow Cartridge: Stainless steel or antiscale polymer.

7. End Connections: Threaded or solder joint.

2.8 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. Acorn Engineering Company; a Division of Morris Group International.

b. Apollo Valves; a part of Aalberts Integrated Piping Systems.

c. Cash Acme Plumbing Products; an RWC brand.

d. POWERS; A Watts Water Technologies Company.

e. Symmons Industries, Inc.

f. Taco Comfort Solutions.

g. WATTS; A Watts Water Technologies Company.

h. Zurn Industries, LLC.

2. Standard: ASSE 1070.

3. Pressure Rating: 125 psig.

4. Type: Thermostatically controlled, water mixing valve.

5. Material: Bronze body with corrosion-resistant interior components.

6. Connections: Threaded union inlets and outlet.

7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

8. Tempered-Water Setting: 120 deg F.

9. Tempered-Water Design Flow Rate: 2.0

10. Valve Finish: Chrome plated.

B. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Caleffi North America.

b. Lawler Manufacturing Company, Inc.

c. POWERS; A Watts Water Technologies Company.

d. Zurn Industries, LLC.

e. Acorn Controls; a Division of Morris Group International.

2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.

3. Pressure Rating: 125 psig minimum unless otherwise indicated.

4. Material: Bronze body with corrosion-resistant interior components.

5. Temperature Control: Adjustable.

6. Connections: Threaded inlets and outlet.

7. Finish: Chrome plated.

8. Tempered-Water Setting: 110 deg F.

9. Tempered-Water Design Flow Rate: 0 – 1.5 gpm.

2.9 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Keckley Company.

   b. WATTS; A Watts Water Technologies Company.

   c. Zurn Industries, LLC.

   d. Caleffi North America.

2. Pressure Rating: 125 psig minimum unless otherwise indicated.

3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.

4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

5. Screen: Stainless steel with round perforations unless otherwise indicated.

6. Perforation Size:

   a. Strainers NPS 2 and Smaller: 0.020 inch.

   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.

   c. Strainers NPS 5 and Larger: 0.10 inch.

7. Drain: Factory-installed, hose-end drain valve.

2.10 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Guy Gray, IPS Corporation.

b. Oatey Co.

2. Mounting: Recessed. Fire rated where installed in fire rated assembly.

3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.

4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.

5. Drain Outlet Connection: NPS 2.

6. Accessory: Water hammer arresters.

7. Supply Shutoff Fittings: NPS ½, quarter-turn ball valves and NPS 1/2 copper, water tubing.

8. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.

9. Inlet Hoses: Two 60-inch-long, rubber, household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.

10. Drain Hose: One 48-inch-long, rubber, household clothes washer drain hose with hooked end.

B. Icemaker and Coffee Maker Outlet Boxes:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Guy Gray, IPS Corporation.

b. Oatey Co.

2. Mounting: Recessed. Fire rated where installed in fire rated assembly.

3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.

4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.

5. Accessory: Water hammer arrestor.

6. Supply Shutoff Fitting: NPS ½, quarter turn ball valve and NPS 1/2 copper, water tubing.

2.11 HOSE BIBBS

A. Hose Bibbs:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.

b. MIFAB, Inc.

c. WATTS; A Watts Water Technologies Company.

d. Woodford Manufacturing Company.

e. Zurn Industries, LLC.

f. Josam Company.

2. Standard: ASME A112.18.1 for sediment faucets.

3. Body Material: Bronze.

4. Seat: Bronze, replaceable.

5. Supply Connections: NPS 3/4 threaded or solder-joint inlet.

6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.

7. Pressure Rating: 125 psig.

8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.

10. Finish for Service Areas: Chrome or nickel plated.

11. Finish for Finished Rooms: Chrome or nickel plated.

12. Operation for Equipment Rooms: Wheel handle or operating key.

13. Operation for Service Areas: Wheel handle.

14. Operation for Finished Rooms: Operating key.

15. Include operating key with each operating-key hose bibb.

16. Include wall flange with each chrome- or nickel-plated hose bibb.

2.12 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.

2. Pressure Rating: 400-psig minimum CWP.

3. Size: NPS 3/4.

4. Body: Copper alloy.

5. Ball: Chrome-plated brass.

6. Seats and Seals: Replaceable.

7. Handle: Vinyl-covered steel.

8. Inlet: Threaded or solder joint.

9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.

2. Pressure Rating: 200-psig minimum CWP or Class 125.

3. Size: NPS 3/4.

4. Body: Copper alloy or ASTM B62 bronze.

5. Drain: NPS 1/8 side outlet with cap.

2.13 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMTROL, Inc.

b. Jay R. Smith Mfg Co; a division of Morris Group International.

c. MIFAB, Inc.

d. Precision Plumbing Products.

e. ProFlo; a Ferguson Enterprises, Inc. brand.

f. Sioux Chief Manufacturing Company, Inc.

g. WATTS; A Watts Water Technologies Company.

h. Zurn Industries, LLC.

i. Josam Company.

2. Standard: ASSE 1010 or PDI-WH 201.

3. Type: Metal bellows.

4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.14 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.

2. Mason Industries, Inc.

3. Metraflex Company (The).

B. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.

2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.

3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.15 WATER METERS

A. Displacement-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Badger Meter, Inc.

b. Mueller Systems, LLC; a subsidiary of Mueller Water Products, Inc.

c. Neptune Technology Group Inc.

d. Sensus; a Xylem brand.

2. Standard: AWWA C700.

3. Pressure Rating: 150-psig working pressure.

4. Body Design: Nutating disc; totalization meter.

5. Registration: In gallons or cubic feet as required by utility company.

a. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

1) System to be capable of transmitting data using AMR/AMI technology.

6. Case: Bronze.

7. End Connections: Threaded or flanged.

B. Turbine-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Badger Meter, Inc.

b. Mueller Systems, LLC; a subsidiary of Mueller Water Products, Inc.

c. Neptune Technology Group Inc.

d. Niagara Meters.

2. Standard: AWWA C701.

3. Pressure Rating: 150 psig working pressure.

4. Body Design: Turbine; totalization meter.

5. Registration: In gallons or cubic feet as required by utility company.

a. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

1) System to be capable of transmitting data using AMR/AMI technology.

6. Case: Bronze.

7. End Connections: Threaded or flanged.

C. Compound-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Badger Meter, Inc.

b. Mueller Systems, LLC; a subsidiary of Mueller Water Products, Inc.

c. Neptune Technology Group Inc.

d. Sensus; a Xylem brand.

2. Standard: AWWA C702.

3. Pressure Rating: 150-psig working pressure.

4. Body Design: With integral mainline and bypass meters; totalization meter.

5. Registration: In gallons or cubic feet as required by utility company.

a. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

1) System to be capable of transmitting data using AMR/AMI technology.

6. Case: Coated ductile iron.

7. End Connections: Flanged.

2.16 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.

2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.

3. Float: Replaceable, corrosion-resistant metal.

4. Mechanism and Seat: Stainless steel.

5. Size: NPS 1/2 minimum inlet.

6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.

2. Pressure Rating: 150-psig minimum pressure rating.

3. Float: Replaceable, corrosion-resistant metal.

4. Mechanism and Seat: Stainless steel.

5. Size: NPS 3/8 minimum inlet.

6. Inlet and Vent Outlet End Connections: Threaded.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.

2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.

3. Do not install bypass piping around backflow preventers.

B. Solenoid Valves: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.

C. Soelnoid Valves: Test for signal strength before valve installation. Install automatic shutoff valve downstream from main domestic water shutoff valve. Install valve controller in an accessible location with sensors in areas where water is likely to accumulate.

D. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.

E. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Y-Pattern Strainers: For water, install on inlet side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

G. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061053 "Miscellaneous Rough Carpentry."

H. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

I. Install air vents at high points of water piping system.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

A. Connect control wiring."

3.5 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Solenoid valves.
5. Balancing valves.
6. Temperature-actuated, water mixing valves.
7. Outlet boxes.
8. Water meters.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.6 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.

D. Adjust each reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections.

1. Test each reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.
4. Fire-rated plenum piping wrap.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

C. Build American Design Submittals:

1. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

1.5 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10 ft. head of water.

2. Waste, Force-Main Piping: 50 psig.

2.2 PIPING MATERIALS

A. Piping materials to bear label, stamp, or other markings of specified testing agency.

B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings:

1. Marked with CISPI collective trademark.

2. ASTM A74, service cast iron.

B. Gaskets: ASTM C564, rubber.

C. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.4 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS – EPOXY-COATED CAST IRON

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DuRa Pipe as manufactured by AB&I Foundry.

b. Edge HP Iron as manufactured by Charlotte Pipe.

c. New Age Casting.

B. Pipe and Fittings:

1. Marked with CISPI collective trademark.
2. ASTM A74, service cast iron.
3. ASTM A88.
4. CISPI 301.

C. Gaskets: ASTM C564, rubber.

D. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

E. Coatings: Internal and external factory-applied epoxy coating meeting EN877.

1. Minimum epoxy coating thicknesses:

a. Interior: 5 mil.

b. Exterior: 2.5 mil.

2.5 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings:

1. Marked with CISPI collective trademark.
2. ASTM A888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Couplings shall bear CISPI collective trademark.
2. Standards: ASTM C1277 and CISPI 310.
3. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

C. Cast-Iron, Hubless-Piping Couplings:

1. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.6 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.

B. Hard Copper Tube: ASTM B88, Type L and Type M, water tube, drawn temper.

C. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

D. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

E. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

2.7 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.

B. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Solvent Cement: ASTM D2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.

2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

3. Unshielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Dallas Specialty & Mfg. Co.

2) Fernco Inc.

3) Mission Rubber Company; a division of MCP Industries, Inc.

4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

b. Standard: ASTM C1173.

c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

d. End Connections: Same size as and compatible with pipes to be joined.

e. Sleeve Materials:

1) For Cast-Iron Soil Pipes: ASTM C564, rubber.

2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.

3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cascade Waterworks Mfg. Co.

2) Mission Rubber Company; a division of MCP Industries, Inc.

b. Standard: ASTM C1460.

c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

d. End Connections: Same size as and compatible with pipes to be joined.

5. Pressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Apollo Valves; a part of Aalberts Integrated Piping Systems.

2) Cascade Waterworks Mfg. Co.

b. Standard: AWWA C219.

c. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

d. Center-Sleeve Material: Manufacturer's standard.

e. Gasket Material: Natural or synthetic rubber.

f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

2. Dielectric Unions:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Capitol Manufacturing Company.

2) Central Plastics Company.

3) Hart Industries International, Inc.

4) Jomar International Ltd.

5) Matco-Norca, Inc.

6) McDonald, A. Y. Mfg. Co.

7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.

8) Wilkins; a Zurn company.

b. Description:

1) Standard: ASSE 1079.

2) Pressure Rating: 125 psig minimum at 180 deg F.

3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Capitol Manufacturing Company.

2) GF Piping Systems: Georg Fischer LLC.

3) Matco-Norca.

4) Watts Water Technologies; a Watts company.

5) Zurn Industries, LLC.

b. Description:

1) Standard: ASSE 1079.

2) Factory-fabricated, bolted, companion-flange assembly.

3) Pressure Rating: 125 psig minimum at 180 deg F.

4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Advance Products & Systems, LLC.

2) CALPICO, Inc.

3) GF Piping Systems: Georg Fischer LLC.

b. Description:

1) Nonconducting materials for field assembly of companion flanges.

2) Pressure Rating: 150 psig.

3) Gasket: Neoprene or phenolic.

4) Bolt Sleeves: Phenolic or polyethylene.

5) Washers: Phenolic with steel backing washers.

6) Flanges in “Dielectric Flanges” Subparagraph below are available in at least NPS 1-1/2 to NPS 4 (DN 40 to DN 100).

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Elster Perfection.

2) Grinnell Mechanical Products.

3) Matco-Norca, Inc.

4) Precision Plumbing Products, Inc.

5) Victaulic Company.

b. Description:

1) Standard: IAPMO PS 66.

2) Electroplated steel nipple.

3) Pressure Rating: 300 psig at 225 deg F.

4) End Connections: Male threaded or grooved.

5) Lining: Inert and noncorrosive, propylene.

2.9 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural.

2.10 FIRE-RATED PLENUM PIPING WRAP

A. Basis of Design Product:

1. Subject to compliance with requirements, provide Fire Barrier Plenum Wrap 5A+ as manufactured by 3M, or approved equal.

B. Standard: ASTM E84, UL 910, and UL 1887.

C. Material: Inorganic fiber blanket encapsulated with a scrim-reinforced foil.

D. Thickness: 1/2 inch thick blanket, 6 lb/cu. ft. density.

E. Installation: Install per manufacturer’s written specifications for all non-plenum rated plastic piping installed in plenum return areas of the project.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.

2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.

2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.

4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.

2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.

2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.

3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping in accordance with 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 in accordance with ASTM A674 or AWWA C105/A 21.5.

N. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."

O. Install aboveground PVC piping in accordance with ASTM D2665.

P. Install underground PVC piping in accordance with ASTM D2321.

Q. Install engineered soil and waste and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.

2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.

3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

R. Install underground, ductile-iron, force-main piping according to AWWA C600.

1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.

2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

3. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.

S. Install force mains at elevations indicated.

T. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install drains in sanitary waste gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

U. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.

C. Hubless, Cast-Iron Soil Piping Coupled Joints:

1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.

1. Cut threads full and clean using sharp dies.

2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

c. Do not use pipe sections that have cracked or open welds.

E. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.

F. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.

3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.

2. In Drainage Piping: Shielded, nonpressure transition couplings.

3. In Aboveground Force Main Piping: Fitting-type transition couplings.

4. In Underground Force Main Piping:

a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523 "General Duty Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.

2. Install full-port ball valve for piping NPS 2 and smaller.

3. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.

2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.

3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.

4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.

5. Vertical Piping: MSS Type 8 or Type 42 clamps.

6. Install individual, straight, horizontal piping runs:

a. 100 Ft. and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Ft.: MSS Type 43, adjustable roller hangers.

c. Longer Than 100 Ft. if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Ft. or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.

8. Base of Vertical Piping: MSS Type 52 spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.

2. NPS 3: 60 inches with 1/2-inch rod.

3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.

5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.

6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.

2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

3. NPS 2-1/2: 108 inches with 1/2-inch rod.

4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.

5. NPS 6: 10 feet with 5/8-inch rod.

6. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.

2. NPS 3: 48 inches with 1/2-inch rod.

3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.

4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.

5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

J. Install supports for vertical PVC piping every 48 inches.

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.

4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.

5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."

6. Equipment: Connect waste piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.

2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections in accordance with 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.

3.8 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping in accordance with 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.

E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.

a. Isolate test source and allow to stand for four hours.

b. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 6 and smaller shall be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, soil and waste piping NPS 8 and smaller located in return air plenums shall be one of the following:

1. Hard copper tube, Type L; copper DWV fittings; and soldered joints.

2. Hubless, cast-iron soil pipe and fittings; cast-iron hubless-piping couplings; coupled joints.

3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. Provide plenum fire wrap covering all PVC piping exposed to plenum return areas.

4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Aboveground, pumped waste piping NPS 3 and smaller shall be one of the following:

1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.

2. Solid-wall PVC pipe, Schedule 40, with solvent-weld pressure fittings.

3. Dissimilar Pipe-Material Couplings: Shielded, pressure transition couplings.

E. Aboveground indirect waste piping in kitchen and food prep areas NPS 4 and smaller shall be the following:

1. Hard copper tube, Type L; copper DWV fittings; and soldered joints.

F. Aboveground, vent piping NPS 8 and smaller shall be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

G. Aboveground, vent piping NPS 6 and smaller located in return air plenums shall be one of the following:

1. Hard copper tube, Type L; copper DWV fittings; and soldered joints.

2. Hubless, cast-iron soil pipe and fittings; cast-iron hubless-piping couplings; coupled joints.

3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints. Provide plenum fire wrap covering all PVC piping exposed to plenum return areas.

4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

H. Underground, soil, waste, and vent piping NPS 8 and smaller shall be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

I. Underground, sanitary & grease waste piping NPS 6 and smaller shall be the following:

1. Epoxy-coated, service-weight, cast-iron soil piping; gaskets; and gasketed joints.

2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

J. Underground, heat-traced sanitary & grease waste piping NPS 6 and smaller shall be the following:

1. Epoxy-coated, service-weight, cast-iron soil piping; gaskets; and gasketed joints.

2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

K. Underground sanitary-sewage force mains NPS 4 and smaller shall be the following:

1. Ductile-iron, mechanical-joint piping and mechanical joints.

2. Ductile-iron, push-on-joint piping and push-on joints.

3. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.

END OF SECTION 221316

SECTION 221319 - 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. Section Includes:

1. Cleanouts.
2. Air admittance valves.
3. Through-penetration firestop assemblies.
4. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Metal and concrete interceptors outside the building, grease interceptors, grease-removal devices, oil interceptors, and solids interceptors.

C. Build American Design Submittals:

1. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

1.3 DEFINITIONS

A. ABS: Acrylonitrile butadiene styrene.

B. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show fabrication and installation details for frost-resistant vent terminals.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

A. Floor Cleanouts with Cover:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.

b. Josam Company.

c. WATTS; A Watts Water Technologies Company.

d. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M.

3. Size: Same as connected drainage piping

4. Body Material: Hubless, cast-iron soil pipe as required to match connected piping.

5. Closure: Countersunk or raised-head, brass plug.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

7. Cover: Provide material indicated on plumbing fixture schedules. Install flush with finished floor and level. Seal gap between cleanout cover and floor watertight.

B. Wall Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Jay R. Smith Mfg Co; a division of Morris Group International.

    b. Josam Company.

    c. WATTS; A Watts Water Technologies Company.

    d. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M. Include wall access.

3. Size: Same as connected drainage piping.

4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.

5. Closure Plug:

    a. Brass.

    b. Countersunk or raised head.

    c. Drilled and threaded for cover attachment screw.

    d. Size: Same as or not more than one size smaller than cleanout size.

6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

7. Wall Access, Frame and Cover: Square, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

8. All wall cleanouts and covers are to be painted to match adjacent wall surfaces.

2.3 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Oatey Co.

    b. ProVent Systems.

    c. Studor, Inc.

2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.

3. Housing: Plastic.

4. Operation: Mechanical sealing diaphragm.

5. Size: Same as connected fixture or branch vent piping.

B. Wall Box for Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Oatey Co.

b. Sioux Chief Manufacturing Company, Inc.

c. Studor, Inc.

2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.

3. Size: Approximately 6 inches wide by 6 inches high by 4 inches deep.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hilti.

b. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.

3. Size: Same as connected soil, waste, or vent stack.

4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.

6. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.

2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.

2. Size: Same as connected waste piping.

a. NPS 2: 4-inch-minimum water seal.

b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Inline Trap Seal Device:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sureseal by Rectorseal or comparable product by one of the following:

a. Green Drain, Inc.

b. Josam Company.

c. MIFAB, Inc.

d. RectorSeal Plumbing; A CSW Industrials Company.

e. Zurn Industries, LLC.

2. Description:

a. Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.

b. HDPE housing with heavy duty silicone diaphragm and soft EPDM rubber sealing gasket.

3. Standard: Tested and certified in accordance with ASSE 1072.

4. Listing: ICC-ES or IAPMO listed.

5. Size: Same as floor drain outlet or strainer throat.

D. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.

2. Body: Bronze or cast iron.

3. Inlet: Opening in top of body.

4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

1. Description: Manufactured cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.

2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.

2. Size: Same as connected stack vent or vent stack.

G. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.

2. Size: Same as connected stack vent or vent stack.

H. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.

2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

I. Expansion Joints:

1. Standard: ASME A112.6.4.

2. Body: Cast iron with bronze sleeve, packing, and gland.

3. End Connections: Matching connected piping.

4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. 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.

E. Install fixture air-admittance valves on fixture drain piping where indicated on drawings.

F. Install air-admittance-valve wall boxes recessed in wall.

G. Assemble open drain fittings and install with top of hub 2 inches above floor.

H. Install deep-seal traps on floor drains and other waste outlets if indicated.

I. Install trap seal protection devices on all floor drains, floor sinks, and other fixtures as indicated on plans.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

L. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

M. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

N. Install vent caps on each vent pipe passing through roof.

O. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

P. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

Q. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

R. Install wood-blocking reinforcement for wall-mounting-type specialties.

S. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

T. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

U. Grease Interceptors: Connect inlet and outlet to unit, and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.2 PIPING CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 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.

2. Copper Sheets: Solder joints of copper sheets.

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. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

F. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 224200 - COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial lavatories.
2. Commercial showers.
3. Commercial sinks.
4. Commercial urinals.
5. Commercial water closets.
6. Flushometer valves.
7. Toilet seats.
8. Fixture carriers.

1.2 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings:

1. Plans, elevations, sections, and mounting details.
2. Details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Diagrams for power, signal, and control wiring.

C. Build American Design Submittals:

1. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories and/or counter-mounted sinks.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Lavatory faucets, sink faucets, shower valves, and wash fountain spray heads and faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 COMMERCIAL LAVATORIES

A. Lavatories, Counter Mounted:

1. Lavatory, Counter Mounted - Vitreous China, Self-Rimming, Rectangular:

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard

b. Kohler

c. Zurn

3. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.

b. Type: Self-rimming for above-counter mounting.

c. Nominal Size: Rectangular, 21 by 19 inches (533 by 483 mm) nominal.

d. Faucet-Hole Punching: Three holes, 4-inch (102-mm) centers.

e. Faucet-Hole Location: Top.

f. Color: White.

g. Mounting Material: Sealant.

B. Lavatories, Wall Mounted:

1. Lavatories, Wall Mounted - Vitreous China, Rectangular, Wheelchair:

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. American Standard

   b. Kohler

   c. Zurn

3. Fixture:

   a. Standard: ASME A112.19.2/CSA B45.1.

      1) Type: Wheelchair.

      2) Nominal Size: Rectangular, 27 by 20 inches (686 by 508 mm).

      3) Faucet-Hole Punching: Three holes, 2-inch (51-mm) centers Three holes, 4-inch (102 mm) centers.

      4) Faucet-Hole Location: Top.

      5) Color: White.

      6) Mounting: For concealed-arm carrier.

   b. Faucet: Insert lavatory faucet designation from "Lavatory Faucets, Manually Operated" or "Lavatory Faucets, Automatically Operated" Paragraph.

   c. Support: Lavatory carrier, floor affixed with steel uprights, exposed-arm concealed-arm.

   d. Lavatory Mounting Height: Accessible in accordance with ICC A117.1.

4. Lavatories, Wall Mounted - Vitreous China, Corner Type:

5. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. American Standard

   b. Kohler

   c. Zurn

6. Fixture:

   a. Standard: ASME A112.19.2/CSA B45.1.

1) Type: Three-sided-front apron with three-sided back.

2) Nominal Size: Corner, 16 by 16 inches (406 by 406 mm).

3) Faucet-Hole Punching: Three holes, 2-inch (51-mm) centers.

4) Faucet-Hole Location: Back wall.

5) Color: White.

6) Mounting Materials: Wall brackets.

b. Faucet: Manufacturer's standard; factory installed.

c. Support: Lavatory carrier, framing affixed Lavatory carrier, floor affixed with steel uprights.

d. Lavatory Mounting Height: Standard Accessible in accordance with ICC A117.1.

C. Lavatory Faucets, Manually Operated:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.

b. Chicago Faucets; Geberit Group.

c. Delta Faucet Company.

d. Elkay.

2. Standard: ASME A112.18.1/CSA B125.1.

3. Operation Type: Two handle, mixing, General duty.

4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.

5. Body Type: Centerset.

6. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.

7. Finish: Polished chrome plate.

8. Maximum Flow Rate: 0.5 gpm (1.9 L/min.).

9. Maximum Flow: 0.25 gal. (0.95 L) per metering cycle.

10. Mounting Type: Deck, exposed.

11. Valve Handle(s): Wrist blade, 4 inches (102 mm).

12. Spout: Rigid type.

13. Spout Outlet: Aerator.

14. Operation: Compression, manual.

15. Drain: Not part of faucet.

D. Lavatory Supply Fittings:

1. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.

2. Standard: ASME A112.18.1/CSA B125.1.

3. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.

4. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

5. Operation: Wheel handle.

6. Risers:

a. NPS 3/8 (DN 10).

b. ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel, flexible hose riser.

E. Lavatory Waste Fittings:

1. Standard: ASME A112.18.2/CSA B125.2.

2. Drain: Grid type with NPS 1-1/4 (DN 32) offset and straight tailpiece.

3. Trap:

a. Size: NPS 1-1/2 by NPS 1-1/4 (DN 40 by DN 32).

b. Material:

1) Stainless steel, two-piece trap and swivel elbow with 0.012-inch (0.30-mm-) thick stainless steel tube to wall, and stainless steel wall flange.

2.3 COMMERCIAL SHOWERS

A. Showers, Individual:

1. Showers, Individual - FRP, One Piece without Top:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Florestone Products Co., Inc.

2) Freedom Showers

b. Source Limitations: Obtain FRP showers without top from single source from single manufacturer.

c. Description: FRP shower enclosure with valve and receptor and appurtenances.

d. Standard: CSA B45.5/IAPMO Z124.

e. Style: Accessible in accordance with ICC A117.

f. Shower Head and Shower Valve: Per Schedule

g. Shower Nominal Size and Shape: 36 by 36 inches (914 by 914 mm) square.

h. Color: White.

i. Outlet: Drain with NPS 2 (DN 50) outlet.

j. Shower Rod and Curtain: Required.

k. Grab Bar: ASTM F446, mounted on support area back wall.

l. Shower Head and Shower Valve: Manufacturer's standard fitting assembly

m. Supplies: NPS 1/2 (DN 15) copper tubing with ball, gate, or globe valves.

n. Drain: Grid, NPS 2 (DN 50).

B. Shower Valve Assemblies:

1. Shower Valve Assemblies - Single-Handle, Pressure-Balanced Mixing Valve with Head

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Moen

b. Delta

c. American Standard

d. Kohler

3. Source Limitations: Obtain shower heads and shower valves from single source from single manufacturer.

4. Description: Single-handle, accessible, pressure-balance mixing valve with hot- and cold-water indicators; diverting valve check stops; and hose with handheld shower head shower head.

5. Shower Valve:

    a. Standards:

        1) ASME A112.18.1/CSA B125.1.

        2) ASSE 1016/ASME A112.1016/CSA B125.16.

        3) Body Material: Solid brass.

        4) Finish: Polished chrome plate.

        5) Mounting: Concealed.

        6) Operation: Single-handle, twist or rotate control.

        7) Antiscald Device: Integral with mixing valve.

        8) Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

    b. Supply Connections: NPS 1/2 (DN 15).

    c. Shower Head:

        1) Standard: ASME A112.18.1/CSA B125.1.

        2) Type: Ball joint with arm and flange.

        3) EPA WaterSense: Required.

        4) Shower Head Maximum Flow Rate: 2.0 gpm (7.6 L/min.).

        5) Shower Head Material: Metallic with chrome-plated finish.

        6) Spray Pattern: Adjustable.

        7) Integral Volume Control: Not required.

        8) Temperature Indicator: Integral with shower valve.

6. Shower Valve Assemblies - Single-Handle, Thermostatic Mixing Valve with Head:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Lawler Manufacturing Company, Inc.

        2) POWERS; A Watts Water Technologies Company.

    b. Source Limitations: Obtain shower heads and shower valves from single source from single manufacturer.

c. Description: Single-handle, accessible, thermostatic mixing valve with hot- and cold-water indicators; diverting valve check stops; and hose with handheld shower head shower head.

d. Shower Valve:

1) Standards:

a) ASME A112.18.1/CSA B125.1.

b) ASSE 1016/ASME A112.1016/CSA B125.16.

2) Body Material: Solid brass.

3) Finish: Polished chrome plate.

4) Mounting: Concealed.

5) Operation: Single-handle, twist or rotate control.

6) Antiscald Device: Integral with mixing valve.

7) Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

e. Supply Connections: NPS 1/2 (DN 15).

f. Shower Head:

1) Standard: ASME A112.18.1/CSA B125.1.

2) Type: Ball joint with arm and flange.

3) EPA WaterSense: Required.

4) Shower Head Maximum Flow Rate: 2.0 gpm (7.6 L/min.).

5) Shower Head Material: Metallic with chrome-plated finish.

6) Spray Pattern: Adjustable.

7) Integral Volume Control: Not required.

8) Temperature Indicator: Integral with valve.

7. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

8. Characteristics: Nonshrink; recommended for interior and exterior applications.

9. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.

10. Packaging: Premixed and factory packaged.

2.4 COMMERCIAL SINKS

A. Kitchen/Utility Sinks:

1. Kitchen/Utility Sinks, Counter Mounted - Stainless Steel:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Advance Tabco.

2) Amerisink Inc.

3) Eagle Group.

4) Elkay.

b. Source Limitations: Obtain sinks from single source from single manufacturer.

c. Fixture:

1) Standard: ASME A112.19.3/CSA B45.4.

2) Type: Stainless steel, self-rimming, sound-deadened unit less ledge back.

3) Number of Compartments: One.

4) Material: 18 gauge, Type 304 stainless steel.

5) Compartment:

a) Drain: Grid with NPS 1-1/2 (DN 40) tailpiece and twist drain or NPS 1-1/2 (DN 40) tailpiece with stopper.

b) Drain Location: Centered in compartment.

c) Depth: Accessible in accordance with ICC A117.1.

d. Faucet(s): As scheduled

1) Number Required: One.

2) Mounting: On ledge.

e. Supply Fittings:

1) Standard: ASME A112.18.1/CSA B125.1.

2) Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.

a) Operation: Wheel handle.

b) Risers: NPS 1/2 (DN 15), ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

f. Waste Fittings:

1) Standard: ASME A112.18.2/CSA B125.2.

2) Trap(s) Size: NPS 1-1/2 (DN 40).

3) Trap(s) Material:

a) Stainless steel, two-piece trap and swivel elbow with 0.012-inch-(0.30-mm-) thick stainless steel tube to wall; and stainless steel wall flange.

4) Continuous Waste:

a) Size: NPS 1-1/2 (DN 40).

b) Material: Chrome-plated, 17-gauge brass tube.

g. Mounting: On counter with sealant.

B. Handwash Sinks:

1. Handwash Sinks - Stainless Steel:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Advance Tabco.

2) Eagle Group.

3) Elkay.

4) Sloan Valve Company.

b. Source Limitations: Obtain sinks from single source from single manufacturer.

c. Fixture:

1) Standards:

a) ASME A112.19.3/CSA B45.4.

b) NSF 61.

2) Type: stainless steel basin with radius corners, back for faucet, and support brackets.

3) Overall Dimensions: 17 by 16 by 5 inches (430 by 406 by 127 mm).

4) Material: 18 gauge, Type 304 stainless steel.

d. Faucet: as scheduled

e. Supply Fittings: Comply with requirements in "Sink Supply Fittings" Paragraph.

f. Waste Fittings: Comply with requirements in "Sink Waste Fittings" Paragraph.

g. Support: counter mounted

h. Mounting Height: Accessible in accordance with ICC A117.1.

C. Sink Faucets, Manually Operated:

1. Sink Faucets, Manually Operated: Two handle, mixing.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) American Standard.

2) Chicago Faucets; Geberit Group.

3) Elkay.

4) Kohler Co.

5) T&S Brass and Bronze Works, Inc.

b. Source Limitations: Obtain sink faucets from single source from single manufacturer.

c. Standards:

1) ASME A112.18.1/CSA B125.1.

2) NSF 61.

3) NSF 372.

d. Description: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.

e. Body Type: Centerset.

f. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.

g. Finish: Chrome plated.

h. Maximum Flow Rate: 1.0 to 1.28 gpm (3.8 to 4.8 L/min).

i. Mounting Type: Deck, concealed.

j. Valve Handle(s): 4-inch (102-mm) wrist blade.

k. Spout Type: Rigid.

l. Vacuum Breaker: Required for hose outlet.

m. Spout Outlet: Plain end.

2.5 COMMERCIAL URINALS

A. Urinals, Wall Hung:

1. Urinals, Wall Hung - Back Outlet, Siphon Jet:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) American Standard.

2) Gerber Plumbing Fixtures LLC.

3) Kohler Co.

4) Zurn Industries, LLC.

b. Fixture:

1) Standards:

a) ASME A112.19.2/CSA B45.1.

b) ASME A112.19.5/CSA B45.15.

2) Material: Vitreous china.

3) Type: Siphon jet with extended shields.

4) Strainer or Trapway: Manufacturer's standard strainer with integral trap.

5) Water Consumption: 0.25 gpf (1.0 Lpf).

6) Spud Size and Location: NPS 3/4 (DN 20); top.

7) Outlet Size and Location: NPS 2 (DN 50); back.

8) Color: White.

c. Flushometer Valve: as scheduled

d. Waste Fitting:

1) Standard: ASME A112.18.2/CSA B125.2 for coupling.

2) Size: NPS 2 (DN 50).

e. Support: Urinal carrier, floor affixed with steel uprights with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture.

f. Urinal Mounting Height: Accessible in accordance with ICC A117.1.

2.6 COMMERCIAL WATER CLOSETS

A. Water Closets, Floor Mounted:

1. Water Closets, Floor Mounted - Bottom Outlet, Top Spud:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) American Standard.
2) Delany Products.
3) I-Con Systems, Inc.
4) Kohler Co.
5) Sloan Valve Company.
6) TOTO USA, INC.
7) Zurn Industries, LLC.

2. Source Limitations: Obtain water closets from single source from single manufacturer.

3. Standard: ASME A112.19.2/CSA B45.1.

4. Bowl:

a. Material: Vitreous china.

b. Type: Siphon jet.

c. Style: Flushometer valve.

d. Height: Standard.

e. Rim Contour: Elongated.

f. Water Consumption: 1.28 gal. (4.8 L) per flush.

g. Spud Size and Location: NPS 1-1/2 (DN 40); top.

h. Color: White.

5. Toilet Seat: as scheduled

6. Water Closets, Floor Mounted - Bottom Outlet, Close-Coupled Flushometer Tank:

7. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

8. Source Limitations: Obtain water closets from single source from single manufacturer.

9. Standard: ASME A112.19.2/CSA B45.1.

10. Bowl:

    a. Material: Vitreous china.

    b. Type: Siphon jet.

    c. Style: Flushometer tank, pressure assisted.

    d. Height: Accessible in accordance with ICC A117.1.

    e. Rim Contour: Elongated.

    f. Water Consumption: 1.28 gal. (4.8 L) per flush.

    g. Color: White.

2.7 FLUSHOMETER VALVES

A. Flushometer Valves, Manually Operated:

1. Flushometer Valves, Manually Operated - Diaphragm, Lever Handle:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Advanced Modern Technologies Corporation - AMTC.

        2) Sloan Valve Company.

        3) Zurn Industries, LLC.

    b. Source Limitations: Obtain flushometer valve from single source from single manufacturer.

    c. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.

    d. Minimum Pressure Rating: 125 psig (860 kPa).

    e. Features: Include integral check stop and backflow-prevention device.

    f. Material: Brass body with corrosion-resistant components.

    g. Style: Exposed.

    h. Flushometer-Valve Finish: Chrome-plated.

    i. Handle Finish: Chrome plated.

    j. Consumption: 1.28 gal. (4.8 L) per flush.

    k. Minimum Inlet: NPS 1 (DN 25).

    l. Minimum Outlet: NPS 1-1/4 (DN 32).

2. Flushometer Valves, Manually Operated - Piston, Lever Handle:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) American Standard.
      2) Delany Products.
      3) I-Con Systems, Inc.
      4) Kohler Co.
      5) Sloan Valve Company.
      6) TOTO USA, INC.
      7) Zurn Industries, LLC.

   b. Source Limitations: Obtain flushometer valve from single source from single manufacturer.

   c. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.

   d. Minimum Pressure Rating: 125 psig (860 kPa).

   e. Features: Include integral check stop and backflow-prevention device.

   f. Material: Brass body with corrosion-resistant components.

   g. Style: Exposed.

   h. Flushometer-Valve Finish: Chrome-plated.

   i. Handle Finish: Chrome-plated.

   j. Consumption: 1.28 gal. (4.8 L) per flush.

   k. Minimum Inlet: NPS 1 (DN 25).

   l. Minimum Outlet: NPS 1-1/4 (DN 32).

B. Flushometer Valves, Sensor Operated:

1. Flushometer Valves, Sensor Operated - Diaphragm:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) American Standard.
      2) Delany Products.
      3) I-Con Systems, Inc.
      4) Kohler Co.
      5) Sloan Valve Company.
      6) TOTO USA, INC.
      7) Zurn Industries, LLC.

   b. Source Limitations: Obtain flushometer valve from single source from single manufacturer.

c. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.

d. Minimum Pressure Rating: 125 psig (860 kPa).

e. Features: Include integral check stop and backflow-prevention device.

f. Material: Brass body with corrosion-resistant components.

g. Style: Exposed.

h. Exposed Flushometer-Valve Finish: Chrome-plated.

i. Panel Finish: Chrome-plated or stainless steel.

j. Actuator: Side or top mounted; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.

k. Trip Mechanism: Battery-powered electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.

l. Consumption: 1.28 gal. (4.8 L) per flush.

m. Minimum Inlet: NPS 1 (DN 25).

n. Minimum Outlet: NPS 1-1/4 (DN 32).

2. Flushometer Valves, Sensor Operated - Piston, Hardwired:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) American Standard.
2) Hydrotek International, Inc.
3) I-Con Systems, Inc.
4) Moen Incorporated.
5) Sloan Valve Company.
6) Stern Engineering Ltd.
7) Zurn Industries, LLC.

b. Source Limitations: Obtain flushometer valve from single source from single manufacturer.

c. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.

d. Minimum Pressure Rating: 125 psig (860 kPa).

e. Features: Include integral check stop and backflow-prevention device.

f. Material: Brass body with corrosion-resistant components.

g. Style: Exposed.

h. Exposed Flushometer-Valve Finish: Chrome-plated.

i. Panel Finish: Chrome-plated or stainless steel.

j. Trip Mechanism: Hardwired, control-voltage electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.

k. Consumption: 1.28 gal. (4.8 L) per flush.

l. Minimum Inlet: NPS 1 (DN 25).

m. Minimum Outlet: NPS 1-1/4 (DN 32).

C. Flushometer Valves, Sensor Operated - Piston, Battery Powered:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.
b. Hydrotek International, Inc.
c. I-Con Systems, Inc.
d. Kohler Co.
e. Moen Incorporated.
f. Sloan Valve Company.
g. Stern Engineering Ltd.
h. TOTO USA, INC.
i. Zurn Industries, LLC.

2. Source Limitations: Obtain flushometer valve from single source from single manufacturer.

3. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.

4. Minimum Pressure Rating: 125 psig (860 kPa).

5. Features: Include integral check stop and backflow-prevention device.

6. Material: Brass body with corrosion-resistant components.

7. Style: Exposed.

8. Exposed Flushometer-Valve Finish: Chrome plated.

9. Panel Finish: Chrome-plated or stainless steel.

10. Trip Mechanism: Battery-powered electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.

11. Consumption: 1.28 gal. (4.8 L) per flush.

12. Minimum Inlet: NPS 1 (DN 25).

13. Minimum Outlet: NPS 1-1/4 (DN 32).

2.8 TOILET SEATS

A. Toilet Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS; A Watts Water Technologies Company.
e. Wade; a subsidiary of McWane Inc.
f. Zurn Industries, LLC.

2. Source Limitations: Obtain toilet seat from single source from single manufacturer.

3. Standard: IAPMO/ANSI Z124.5.

4. Material: Plastic.

5. Type: Commercial (Heavy duty).

6. Shape: Elongated rim, closed front.

7. Hinge: Self-sustaining, check.

8. Hinge Material: Noncorroding metal.

9. Seat Cover: Required.

10. Color: White.

11. Surface Treatment: Not required.

2.9 FIXTURE CARRIERS

A. Fixture Carriers - Lavatory:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg Co; a division of Morris Group International.
b. Josam Company.
c. MIFAB, Inc.
d. WATTS; A Watts Water Technologies Company.
e. Wade; a subsidiary of McWane Inc.
f. Zurn Industries, LLC.

2. Source Limitations: Obtain lavatory carriers from single source from single manufacturer.

3. Standards:

a. ASME A112.6.1M.

b. ASME A112.6.2.

B. Fixture Carriers - Sink: :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. MIFAB, Inc.
   d. WATTS; A Watts Water Technologies Company.
   e. Wade; a subsidiary of McWane Inc.
   f. Zurn Industries, LLC.

2. Source Limitations: Obtain sink carriers from single source from single manufacturer.

3. Standards:

   a. ASME A112.6.1M.

   b. ASME A112.6.2.

C. Fixture Carriers - Urinal:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. MIFAB, Inc.
   d. WATTS; A Watts Water Technologies Company.
   e. Wade; a subsidiary of McWane Inc.
   f. Zurn Industries, LLC.

2. Source Limitations: Obtain urinal carriers from single source from single manufacturer.

3. Standard: ASME A112.6.1M.

4. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings, gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

D. Fixture Carriers - Water Closet:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Jay R. Smith Mfg Co; a division of Morris Group International.
   b. Josam Company.
   c. MIFAB, Inc.
   d. WATTS; A Watts Water Technologies Company.
   e. Wade; a subsidiary of McWane Inc.
   f. Zurn Industries, LLC.

2. Source Limitations: Obtain water closet carriers from single source from single manufacturer.

3. Standard: ASME A112.6.1M.

4. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings, gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

PART 3 - EXECUTION

3.1 INSTALLATION OF COMMERCIAL PLUMBING FIXTURES

A. Lavatory Installation:

1. Install lavatories level and plumb in accordance with roughing-in drawings.

2. Install supports, affixed to building substrate, for wall-mounted lavatories.

3. Install accessible, wall-mounted lavatories at mounting height in accordance with ICC A117.1.

4. Install water-supply piping with stop on each supply to each lavatory faucet. Install stops in locations that are accessible for ease of operation.

5. Install trap and waste piping on each drain outlet of each lavatory to be connected to sanitary drainage system.

6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

7. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

8. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories.

B. Shower Installation:

1. Assemble shower components in accordance with manufacturers' written instructions.

2. Install showers level and plumb in accordance with roughing-in drawings.

3. Install ball or gate valves in water-supply piping to the shower if supply stops are specified with the shower valve. Comply with ball or gate valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping." Install valves in locations that are accessible for ease of operation.

4. Install shower flow-control fittings with specified maximum flow rates in shower arms.

5. Set shower receptors and shower basins in leveling bed of cement grout.

6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

7. Seal joints between showers, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

C. Sink Installation:

1. Install sinks level and plumb in accordance with roughing-in drawings.

2. Install supports, affixed to building substrate, for wall-mounted sinks.

3. Install accessible, wall-mounted sinks at mounting height in accordance with ICC A117.1.

4. Set floor-mounted sinks in leveling bed of cement grout.

5. Install water-supply piping with stop on each supply to each sink faucet.

   a. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General Duty Valves for Plumbing Piping."

   b. Install stops/valves in locations that are accessible for ease of operation.

6. Install trap and waste piping on each drain outlet of each sink to be connected to sanitary drainage system.

7. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

8. Seal joints between sinks, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

9. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks.

D. Urinal Installation:

1. Install urinals level and plumb in accordance with roughing-in drawings.

2. Install wall-hung, back-outlet urinals onto waste-fitting seals and attached to supports.

3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.

4. Install accessible, wall-mounted urinals at mounting height in accordance with ICC A117.1.

5. Install trap-seal liquid in waterless urinals.

6. Install supports, affixed to building substrate, for wall-hung urinals.

7. Use off-floor carriers with waste fitting and seal for back-outlet urinals.

8. Use carriers without waste fitting for urinals with tubular waste piping.

9. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

10. Measure support height installation from finished floor, not structural floor.

11. Install flushometer-valve, water-supply fitting on each supply to each urinal.

12. Attach supply piping to supports or substrate within pipe spaces behind fixtures.

13. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

14. Install actuators in locations easily reachable for people with disabilities.

15. Install new batteries in battery-powered, electronic-sensor mechanisms.

16. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

17. Seal joints between urinals, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to urinal color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

E. Water Closet Installation:

1. Install water closets level and plumb in accordance with roughing-in drawings.

2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.

3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.

4. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.

5. Use carrier supports with waste-fitting assembly and seal.

6. Install floor-mounted, back-outlet water closets, attached to building floor substrate, onto waste-fitting seals; and attach to support.

7. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals, and affix to building substrate.

8. Measure support height installation from finished floor, not structural floor.

9. Install flushometer-valve, water-supply fitting on each supply to each water closet.

10. Attach supply piping to supports or substrate within pipe spaces behind fixtures.

11. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.

12. Install actuators in locations easily reachable for people with disabilities.

13. Install new batteries in battery-powered, electronic-sensor mechanisms.

14. Install toilet seats on water closets.

15. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

16. Seal joints between water closets, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to water-closet color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 INSTALLATION OF PIPING CONNECTIONS

A. Connect plumbing fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match plumbing fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil, waste, and vent piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible plumbing fixtures.

E. Where installing piping adjacent to water closets and urinals, allow space for service and maintenance.

3.3 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.4 INSTALLATION OF CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring.

3.5 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damages finishes. Replace any fixtures unable to be repaired to the satisfaction of the Owner.

B. Clean plumbing fixtures and associated faucets, valves, flushometer valves, and fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and associated faucets, valves, flushometer valves, and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224200

SECTION 224713 - DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Drinking fountains.
2. Bottle filling stations.
3. Supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include diagrams for power wiring.

C. Build American Design Submittals:

1. All submitted equipment, fixtures and accessories must be Build America Buy American or BABA compliant.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains and bottle filling stations to include in maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 2 of each.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Drinking fountains and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2. Comply with ASME A112.19.3/CSA B45.4 for stainless steel drinking fountains and bottle filling stations.

3. Comply with NSF 42 and NSF 53 for water filters for drinking fountains and bottle filling stations.

4. Comply with ICC A117.1 for accessible drinking fountains and bottle filling stations.

2.2 DRINKING FOUNTAINS

A. Drinking Fountains - Wall-Mounted, Stainless Steel:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or product equal in performance by one of the following:

   a. Elkay Manufacturing Co.

   b. Halsey Taylor.

   c. Haws Corporation.

   d. Murdock Manufacturing; A Morris International Group.

   e. Oasis Corp.

2. Source Limitations: Obtain surface wall-mounted, stainless steel drinking fountains from single source from single manufacturer.

3. Receptor(s):

   a. Shape: Rectangular.

   b. Back Panel: Stainless steel wall plate behind drinking fountain.

   c. Bubblers: One for each receptor, with adjustable stream regulator, located on deck.

   d. Drain: Grid type with NPS 1-1/4 tailpiece.

4. Maximum Water Flow: 0.5 gpm.

5. Control: Push bar.

6. Supply: NPS 3/8 with shutoff valve.

7. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 chrome-plated brass P-trap and waste.

8. Filter: One or more water filters with capacity sized for unit peak flow rate.

9. Cooling System: Integral mounted as specified, electric, hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

    a. Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.

10. Electrical Characteristics:

    a. Volts: 120 V ac.

    b. Phase: Single.

    c. Hertz: 60 Hz.

11. Support: Provide manufacturer's mounting plate and drinking fountain carrier.

12. Drinking Fountain Mounting Height:

    a. Single units: Accessible in accordance with ICC A117.1.

    b. High/low - standard/accessible in accordance with ICC A117.1.

2.3 BOTTLE FILLING STATIONS

A. Bottle Filling Station - Wall-Mounted, ABS/Stainless Steel Combination:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or product equal in performance by one of the following:

    a. Elkay Manufacturing Co.

    b. Halsey Taylor.

    c. Haws Corporation.

    d. Murdock Manufacturing; A Morris International Group.

    e. Oasis Corp.

2. Source Limitations: Obtain surface wall-mounted, ABS/stainless steel combination, bottle filling stations from single source from single manufacturer.

3. Cabinet: ABS/stainless steel combination.

4. Bottle Filler: Sensor activation. Fill rate 0.5 to 1.5 gpm.

5. Drain: Grid type with NPS 1-1/4 tailpiece.

6. Supply: NPS 3/8 with shutoff valve.

7. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.

8. Filter: One or more water filters complying with NSF 42 and NSF 53 and with capacity sized for peak flow rate.

9. Cooling System: Integral mounted as specified, electric, hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

    a. Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.

10. Support: Provide manufacturer's mounting plate and drinking fountain carrier.

11. Bottle Filling Station Mounting Height: Accessible in accordance with ICC A117.1.

12. Electrical Characteristics:

    a. Volts: 120 V ac.

    b. Phase: Single.

    c. Hertz: 60 Hz.

2.4 SUPPORTS

A. Drinking Fountain Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Elkay Manufacturing Co.

    b. Halsey Taylor.

    c. Jay R. Smith Mfg. Co.

    d. Josam Co.

    e. Oasis Corp.

    f. Watts Industries, Inc.

    g. Zurn Industries, LLC.

2. Standard: ASME A112.6.1M.

    a. Type I Hanger-type carrier with two vertical uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

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

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Install recessed, drinking fountains and bottle filling stations secured to wood blocking in wall construction.

C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "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 wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."

G. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for drinking fountain. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

3.5 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.6 CLEANING

A. After installing fixtures, 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.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224713

BARRY ISETT & associates INC
MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 23

Heating, Ventilation, and Air Conditioning

SECTION 230130.52 - EXISTING HVAC AIR DISTRIBUTION SYSTEM CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cleaning existing HVAC air-distribution equipment, ducts, plenums, and system components.

1.2 DEFINITIONS

A. ACAC: American Council for Accredited Certification.

B. AIHA-LAP: American Industrial Hygiene Association Lab Accreditation Program

C. ASCS: Air systems cleaning specialist.

D. CESB: Council of Engineering and Scientific Specialty Boards.

E. CMI: Certified Microbial Investigator.

F. CMC: Certified Microbial Consultant.

G. CMR: Certified Microbial Remediator.

H. CMRS: Certified Microbial Remediation Supervisor.

I. EMLAP: Environmental Microbiology Laboratory Accreditation Program.

J. IEP: Indoor Environmental Professional.

K. IICRC: Institute of Inspection, Cleaning, and Restoration Certification.

L. NADCA: National Air Duct Cleaners Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. ASCS Qualifications: A certified member of NADCA.

1. Certification: Employ an ASCS certified by NADCA on a full-time basis.

2. Supervisor Qualifications: Certified as an ASCS by NADCA.

B. IEP Qualifications: CMI who is certified by ACAC and accredited by CESB.

C. IEP Qualifications: CMC who is certified by ACAC and accredited by CESB.

D. CMR Qualifications: Certified by ACAC and accredited by CESB.

E. CMRS Qualifications: Certified by ACAC and accredited by CESB.

PART 2 - PRODUCTS

2.1 HVAC CLEANING AGENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Apex Engineering Products Corporation.

2. BBJ Environmental Solutions.

3. Goodway Technologies Corporation.

4. Nu-Calgon.

5. QuestVapco Corporation.

B. Description:

1. Formulated for each specific soiled coil condition that needs remedy.

2.2 ANTIMICROBIAL SURFACE TREATMENT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bio-Cide International, Inc.

2. Contec, Inc.

3. Ecolab, Inc.

B. Description: Specific product selected shall be as recommended by the IEP based on the specific antimicrobial needs of the specific Project conditions.

1. Formulated to kill and inhibit growth of microorganisms.

2. EPA-registered for use in HVAC systems and for the specific application in which it will be used.

3. Have no residual action after drying, with zero VOC off-gassing.

4. OSHA compliant.

5. Treatment shall dry clear to allow continued visual observation of the treated surface.

PART 3 - EXECUTION

3.1 PREPARATION

A. Inspect HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.

B. Cleaning Plan: Prepare a written plan for air-distribution system cleaning that includes strategies and step-by-step procedures.

C. Proceed with work only after conditions detrimental to performance of the Work have been corrected and cleaning plan has been approved.

D. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.

E. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning.

3.2 CLEANING

A. Comply with NADCA ACR.

B. Perform electrical lockout and tagout according to Owner's standards or authorities having jurisdiction.

C. Remove non-adhered substances and deposits from within the HVAC system.

D. Systems and Components to Be Cleaned: All air-moving and -distribution equipment.

E. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.

1. Particulate Collection: For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.

2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,

F. Control odors and mist vapors during the cleaning and restoration process.

G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.

H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.

I. Clean all air-distribution devices, registers, grilles, and diffusers.

J. Clean non-adhered substance deposits according to NADCA ACR and the following:

1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.

2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.

3. Clean evaporator coils, reheat coils, and other airstream components.

K. Air-Distribution Systems:

1. Create service openings in the HVAC system as necessary to accommodate cleaning.

2. Mechanically clean air-distribution systems specified to remove all visible contaminants, so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).

L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.

M. Mechanical Cleaning Methodology:

1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.

a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.

b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials, such as duct and plenum liners.

2. Cleaning Mineral-Fiber Insulation Components:

a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR.

b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).

c. Fibrous materials that become wet shall be discarded and replaced.

N. Coil Cleaning:

1. See NADCA ACR, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing coil cleaning verification.

2. Coil drain pans shall be subject to NADCA ACR, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.

3. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.

4. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations.

5. Rinse thoroughly with clean water to remove any latent residues.

O. Application of Antimicrobial Treatment:

1. Apply antimicrobial agents and coatings if active fungal growth is determined by the IEP to be at Condition 2 or Condition 3 status according to IICRC S520, as analyzed by a laboratory accredited by AIHA-LAP with an EMLAP certificate, and with results interpreted by an IEP. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.

2. Apply antimicrobial treatments and coatings after the system is rendered clean.

3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.

4. Microbial remediation shall be performed by a qualified CMR and CMRS.

3.3 CLEANLINESS VERIFICATION

A. Verify cleanliness according to NADCA ACR, "Verification of HVAC System Cleanliness" Section.

B. Surface-Cleaning Verification: Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

C. Verification of Coil Cleaning: Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.

D. Prepare a written cleanliness verification report.

3.4 RESTORATION

A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR, "Restoration and Repair of Mechanical Systems" Section.

B. Restore service openings capable of future reopening. Comply with requirements in Section 233113 "Metal Ducts."

C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 233113 "Metal Ducts."

D. Ensure that closures do not hinder or alter airflow.

E. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

F. Restore manual volume dampers and air-directional mechanical devices inside the system to their marked position on completion of cleaning.

END OF SECTION 230130.52

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. Equipment installation requirements common to equipment sections.

2. Painting and finishing.

3. Concrete bases.

4. Supports and anchorages.

1.3 DEFINITIONS

A. Basis of Design Products:

1. The "basis of design" products named on the contract drawings and throughout the project manual constitute the engineers design.

2. The phrase "or comparable product by one of the following" throughout the project manual implies that the comparable products are accepted as equal; however, the conditions of AIA document A201-2007 regarding shop drawings, product data and samples apply with regards to deviations from the contract documents.

3. If products other than the "basis of design" differ from the engineers design to the extent that modifications to structural, mechanical, electrical, or any other affected discipline's design is required to install the product properly, then all such modifications shall be done at the expense of the Contractor.

B. 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.

C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

F. 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.

G. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.

2. PE: Polyethylene plastic.

3. PVC: Polyvinyl chloride plastic.

H. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

I. Substantial completion: The project stage where the work is sufficiently completed in accordance with the contract documents so the owner can occupy or utilize the scope area for its intended use. This shall be a date determined by the General Contractor in coordination with other trades and the building owner.

1. For phased construction projects, the date of substantial completion may be determined per major scope area or phase of the scope such that the date of substantial completion may not be the same date for all areas of the scope.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Installing Contractor shall submit appropriate forms to Pennsylvania Department of Labor and Industry – Boiler Division for approval of boilers, unfired pressure vessels, or other equipment under their jurisdiction before installation of equipment. Contractor shall also submit

appropriate fees. Contractor shall arrange for inspection and obtain approval for installation. If installation fails inspection, Contractor shall arrange for re-inspection until approval is granted.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section 081113 "Hollow Metal Doors and Frames."

1.7 ACCESS PANELS

A. Contractor shall provide access panels for all concealed equipment, valves, strainers, control devices, cleanouts, traps, and other items and devices requiring maintenance or access for service, adjustment, balancing or manual operation.

1. General maintenance access panels ARE NOT shown on Drawings. Contractor installing the item requiring access shall coordinate locations, sizes, quantities, etc., and shall provide and install access panels as required. Door sizes shall be 12 inches x 12 inches for hand access, 18 inches x 18 inches for shoulder access and 24 inches x 24 inches for full body access where required.

    a. In new construction, the Contractor for General Construction shall provide the rough framed opening, and in the case of flush, frameless access panels in gypsum board applications, shall perform all drywall finishing. The Contractor for General Construction shall paint all access panels that are not prefinished or are otherwise intended to be left exposed.

    b. In existing constriction, the Contractor installing the item requiring access shall cut and patch the required openings and shall provide and install the access panels as required. Unless the surface where the access panel is cut in and patched is already specified to be finished by the General Contractor, the Contractor installing the item requiring access shall paint all access panels that are not prefinished or are otherwise intended to be left exposed.

1.8 LEAD TIMES

A. By submitting a bid for this scope of work, the bidding contractor accepts responsibility to provide all equipment included in their scope of work regardless of lead time. If any individual component or piece of equipment has a notably long lead time, it is the responsibility of the installing bidding contractor to schedule the progress of their submittal review and subsequent ordering of equipment so as to not delay the progress of the project.

1. If a piece of equipment or component has a substantial or variable lead time that the contractor suspects may impact the project schedule, it is their responsibility to submit for approval a suitable alternate product per the specifications that will be delivered in a timely manner and not impact the project schedule.

PART 2 - PRODUCTS (Not Applicable)

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. Insulation shall be installed continuously through openings, hangers, and over valves and pipe fittings unless noted otherwise.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

M. Verify final equipment locations for roughing-in.

N. 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.

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. Pressure-Seal Joints: Use only manufacturer’s listed tooling for installation of pressure-seal fittings.

1. Provide O-ring sealing elements compatible with the fluid conveyed.

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 EQUIPMENT INSTALLATION WHERE ROOFING WORK IS INVOLVED

A. All New Construction:

1. General Contractor shall provide and prepare openings in new work, including all wood blocking, for the proper engagement of work of other Contractors. Upon completion of work by other Prime Contractors affecting roofing work, General Contractor shall perform all required roofing work.

B. Existing construction where new roofing is involved:

1. The Mechanical Contractor shall perform all cutting & patching of the existing construction, except for patching of the roofing assembly, which shall be by the General Contractor. The General Contractor shall provide all blocking and structural support for roof equipment curbs.

C. Existing construction where existing roofing is to remain:

1. The Mechanical Contractor shall perform all cutting & patching of the existing construction, including patching of the roofing membrane, flashing, etc. The Mechanical Contractor shall provide all blocking for roof equipment curbs. Perimeter support for equipment curbs shall be by the General Contractor.

D. See architect’s specifications for further detail.

3.6 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Section 099123 "Interior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

B. Field Welding: Comply with AWS D1.1.

END OF SECTION 230500

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Duct-thermometer mounting brackets.
4. Thermowells.
5. Dial-type pressure gages.
6. Gage attachments.
7. Flowmeters.
8. Thermal-energy meters.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ashcroft
b. Palmer Wahl

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch (76-mm) nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F (deg C).

E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

F. Connector Size: 1/2 inch (13 mm), with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.

H. Window: Plain glass or plastic.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1.5 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ashcroft

   b. Palmer Wahl

2. Standard: ASME B40.200.

3. Case: Cast aluminum; 7-inch (178-mm) nominal size unless otherwise indicated.

4. Case Form: Adjustable angle unless otherwise indicated.

5. Tube: Glass with magnifying lens and blue or red organic liquid.

6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).

7. Window: Glass or plastic.

8. Stem: Aluminum and of length to suit installation.

   a. Design for Air-Duct Installation: With ventilated shroud.

b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.

10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.4 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.

2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.

3. Material for Use with Copper Tubing: CNR or CUNI.

4. Material for Use with Steel Piping: CRES CSA.

5. Type: Stepped shank unless straight or tapered shank is indicated.

6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.

7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.

8. Bore: Diameter required to match thermometer bulb or stem.

9. Insertion Length: Length required to match thermometer bulb or stem.

10. Lagging Extension: Include on thermowells for insulated piping and tubing.

11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.5 DIAL-TYPE PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ashcroft

b. Trerice

c. Noshok

2. Standard: ASME B40.100.

3. Case: Liquid-filled Open-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.

4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.

6. Movement: Mechanical, with link to pressure element and connection to pointer.

7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).

8. Pointer: Dark-colored metal.

9. Window: Glass or plastic.

10. Ring: Metal.

11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ashcroft

b. Trerice

c. Noshok

2. Standard: ASME B40.100.

3. Case: Sealed type; plastic; 4-1/2-inch (114-mm) nominal diameter.

4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.

6. Movement: Mechanical, with link to pressure element and connection to pointer.

7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).

8. Pointer: Dark-colored metal.

9. Window: Glass or plastic.

10. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.6 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 (DN 8 or DN 15) pipe threads.

C. Valves: Brass ball, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

2.7 FLOWMETERS

A. Pitot-Tube Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. McCrometer

   b. Kobold

   c. Eastern Instruments

2. Description: Flowmeter with sensor and indicator.

3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

4. Sensor: Insertion type; for inserting probe in piping and measuring flow directly in gallons per minute (liters per second).

   a. Design: Differential-pressure-type measurement for water.

   b. Construction: Stainless-steel probe of length to span inside of pipe, with integral transmitter and direct-reading scale.

   c. Minimum Pressure Rating: 150 psig (1035 kPa).

   d. Minimum Temperature Rating: 250 deg F (121 deg C).

5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.

6. Integral Transformer: For low-voltage power connection.

7. Accuracy: Plus or minus 3 percent.

8. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).

9. Operating Instructions: Include complete instructions with each flowmeter.

B. Turbine Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McCrometer

b. Kobold

c. Eastern Instruments

2. Description: Flowmeter with sensor and indicator.

3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

4. Sensor: Impeller turbine; for inserting in pipe fitting or for installing in piping and measuring flow directly in gallons per minute (liters per second).

a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for water.

b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.

c. Minimum Pressure Rating: 150 psig (1035 kPa).

d. Minimum Temperature Rating: 180 deg F (82 deg C).

5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.

6. Accuracy: Plus or minus 1-1/2 percent.

7. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).

8. Operating Instructions: Include complete instructions with each flowmeter.

C. Venturi Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McCrometer

b. Kobold

c. Badge Meter

2. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.

3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

4. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.

    a. Design: Differential-pressure-type measurement for water.

    b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.

    c. Minimum Pressure Rating: 250 psig (1725 kPa).

    d. Minimum Temperature Rating: 250 deg F (121 deg C).

    e. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

    f. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged or welded.

    g. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.

5. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- (152-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.

    a. Scale: Gallons per minute (Liters per second).

    b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.

6. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flowmeter element and having two 12-foot (3.7-m) hoses, with carrying case.

    a. Scale: Gallons per minute (Liters per second).

    b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.

7. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).

8. Conversion Chart: Flow rate data compatible with sensor.

9. Operating Instructions: Include complete instructions with each flowmeter.

2.8 THERMAL-ENERGY METERS

A. Impeller-Turbine, Thermal-Energy Meters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. McCrometer

    b. Kobold

    c. Badge Meter

2. Description: System with strainer, flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.

3. Flow Sensor: Impeller turbine with corrosion-resistant-metal body and transmitter; for installing in piping.

   a. Design: Total thermal-energy measurement.

   b. Minimum Pressure Rating: 150 psig (1035 kPa).

   c. Minimum Temperature Range: 40 to 250 deg F (5 to 121 deg C).

4. Temperature Sensors: Insertion-type transducer.

5. Indicator: Solid-state, integrating-type meter with integral battery pack; for wall mounting.

   a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).

   b. Battery Pack: Five-year lithium battery.

6. Accuracy: Plus or minus 1 percent.

7. Display: Visually indicates total fluid volume in gallons (liters) and thermal-energy flow in kilowatts per hour or British thermal units (joules).

8. Strainer: Full size of main line piping.

9. Operating Instructions: Include complete instructions with each thermal-energy meter system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gage for steam.

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flowmeter elements in accessible positions in piping systems.

P. Install wafer-orifice flowmeter elements between pipe flanges.

Q. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

R. Install permanent indicators on walls or brackets in accessible and readable positions.

S. Install connection fittings in accessible locations for attachment to portable indicators.

T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

U. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.

2. Inlet and outlet of each hydronic boiler.

3. Two inlets and two outlets of each chiller.

4. Inlet and outlet of each hydronic coil in air-handling units.

5. Two inlets and two outlets of each hydronic heat exchanger.

6. Inlet and outlet of each thermal-storage tank.

7. Outside-, return-, supply-, and mixed-air ducts.

V. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.

2. Inlet and outlet of each chiller chilled-water and condenser-water connection.

3. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow space for service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.

2. Direct-mounted, metal-case, vapor-actuated type.

3. Industrial-style, liquid-in-glass type.

B. Thermometers at inlets and outlets of each hydronic heat exchanger shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.

2. Direct-mounted, metal-case, vapor-actuated type.

3. Industrial-style, liquid-in-glass type.

C. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.

2. Direct-mounted, metal-case, vapor-actuated type.

3. Industrial-style, liquid-in-glass type.

D. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 20 to 240 deg F and 0 to 150 deg C.

B. Scale Range for Air Ducts: 0 to 150 deg F and minus 20 to plus 70 deg C.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each pressure-reducing valve shall be one of the following:

1. Liquid-filled Solid-front, pressure-relief, direct-mounted, metal case.

2. Sealed, direct-mounted, plastic case.

B. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be one of the following:

1. Sealed Solid-front, pressure-relief, direct-mounted, metal case.

2. Sealed, direct-mounted, plastic case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 160 psi (0 to 1100 kPa).

3.8 FLOWMETER SCHEDULE

A. Flowmeters for Heating, Hot-Water Piping: Pitot-tube Turbine Venturi type.

3.9 THERMAL-ENERGY METER SCHEDULE

A. Thermal-Energy Meters: Impeller-turbine type.

END OF SECTION 230519

SECTION 230523.12 - BALL VALVES FOR HVAC PIPING

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Stainless steel ball valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

PART 2 - PRODUCTS

A. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for cast copper solder-joint connections.
6. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
7. ASME B16.34 for flanged and threaded end connections.
8. ASME B31.1 for power piping valves.
9. ASME B31.9 for building services piping valves.

B. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

D. Valve Sizes: Same as upstream piping unless otherwise indicated.

E. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 (DN 100) and larger.

2. Hand Lever: For quarter-turn valves smaller than NPS 4 (DN 100).

F. Valves in Insulated Piping:

1. Provide 2-inch (50-mm) extended neck stems.

2. Extended operating handles with nonthermal-conductive covering material, and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.

3. Memory stops that are fully adjustable after insulation is applied.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, One Piece:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. KITZ Corporation.

b. WATTS; A Watts Water Technologies Company.

2. Standard: MSS SP-110.

3. CWP Rating: 400 psig (2760 kPa).

4. Body Design: One piece.

5. Body Material: Forged brass.

6. Ends: Threaded.

7. Seats: PTFE.

8. Stem: Brass.

9. Ball: Chrome-plated brass.

10. Port: Reduced.

B. Brass Ball Valves, Two Piece with Full Port and Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A.Y. McDonald Mfg. Co.

b. American Valve, Inc.

c. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

d. Bray Commercial.

e. Center Line; a Crane Co. brand.

f. DynaQuip Controls.

g. Hammond Valve.

h. Jenkins Valves; a Crane Co. brand.

i. Jomar Valve.

j. KITZ Corporation.

k. Lance Valves.

2. Standard: MSS SP-110.

3. SWP Rating: 150 psig (1035 kPa).

4. CWP Rating: 600 psig (4140 kPa).

5. Body Design: Two piece.

6. Body Material: Forged brass.

7. Ends: Threaded or soldered.

8. Seats: PTFE.

9. Stem: Brass.

10. Ball: Chrome-plated brass.

11. Port: Full.

C. Brass Ball Valves, Two Piece with Full Port and Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.

b. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

c. Crane Fluid Systems; Crane Co.

d. Jomar Valve.

e. Milwaukee Valve Company.

2. Standard: MSS SP-110; IAPMO/ANSI Z1157.

3. CWP Rating: 600 psig (4140 kPa).

4. Body Design: Two piece.

5. Body Material: Forged brass.

6. Ends: Press.

7. Seats: PTFE or RPTFE.

8. Stem: Brass.

9. Ball: Chrome-plated brass.

10. Port: Full.

11. O-Ring Seal: Buna-N or EPDM.

D. Brass Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Threaded Ends or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. A.Y. McDonald Mfg. Co.

b. American Valve, Inc.

c. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

d. Jomar Valve.

2. Standard: MSS SP-110.

3. SWP Rating: 150 psig (1035 kPa).

4. CWP Rating: 600 psig (4140 kPa).

5. Body Design: Two piece.

6. Body Material: Forged brass.

7. Ends: Threaded or soldered.

8. Seats: PTFE.

9. Stem: Stainless steel.

10. Ball: Stainless steel, vented.

11. Port: Full.

E. Brass Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.

b. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

c. Crane Fluid Systems; Crane Co.

d. Jomar Valve.

e. Milwaukee Valve Company.

f. NIBCO INC.

2. Standard: MSS SP-110; IAPMO/ANSI Z1157.

3. CWP Rating: Minimum 200 psig (1380 kPa).

4. Body Design: Two piece.

5. Body Material: Forged brass.

6. Ends: Press.

7. Press-End Connections Rating: Minimum 200 psig (1380 kPa).

8. Seats: PTFE or RPTFE.

9. Stem: Stainless steel.

10. Ball: Stainless steel, vented.

11. Port: Full.

12. O-Ring Seal: Buna-N or EPDM.

F. Brass Ball Valves, Two Piece with Regular Port and Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A.Y. McDonald Mfg. Co.

b. American Valve, Inc.

c. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

d. Jomar Valve.

e. Milwaukee Valve Company.

2. Standard: MSS SP-110.

3. SWP Rating: 150 psig (1035 kPa).

4. CWP Rating: 600 psig (4140 kPa).

5. Body Design: Two piece.

6. Body Material: Forged brass.

7. Ends: Threaded or soldered.

8. Seats: PTFE.

9. Stem: Brass.

10. Ball: Chrome-plated brass.

11. Port: Regular.

G. Brass Ball Valves, Two Piece with Regular Port and Stainless Steel Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.

b. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

c. Jomar Valve.

d. Milwaukee Valve Company.

2. Standard: MSS SP-110.

3. SWP Rating: 150 psig (1035 kPa).

4. CWP Rating: 600 psig (4140 kPa).

5. Body Design: Two piece.

6. Body Material: Brass or bronze.

7. Ends: Threaded or soldered.

8. Seats: PTFE.

9. Stem: Stainless steel.

10. Ball: Stainless steel, vented.

11. Port: Regular.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, One Piece with Bronze Trim, Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.

b. WATTS; A Watts Water Technologies Company.

2. Standard: MSS SP-110.

3. CWP Rating: 400 psig (2760 kPa).

4. Body Design: One piece.

5. Body Material: Bronze.

6. Ends: Threaded.

7. Seats: PTFE.

8. Stem: Bronze.

9. Ball: Chrome-plated brass.

10. Port: Reduced.

B. Bronze Ball Valves, One Piece with Stainless Steel Trim, Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.

b. WATTS; A Watts Water Technologies Company.

2. Standard: MSS SP-110.

3. CWP Rating: 600 psig (4140 kPa).

4. Body Design: One piece.

5. Body Material: Bronze.

6. Ends: Threaded.

7. Seats: PTFE.

8. Stem: Stainless steel.

9. Ball: Stainless steel, vented.

10. Port: Reduced.

C. Bronze Ball Valves, Two Piece with Full Port and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

b. Milwaukee Valve Company.

c. NIBCO INC.

d. WATTS; A Watts Water Technologies Company.

e. Zurn; Zurn Elkay.

2. Standard: MSS SP-110.

3. SWP Rating: 150 psig (1035 kPa).

4. CWP Rating: 600 psig (4140 kPa).

5. Body Design: Two piece.

6. Body Material: Bronze.

7. Ends: Threaded or soldered.

8. Seats: PTFE.

9. Stem: Bronze.

10. Ball: Chrome-plated brass.

11. Port: Full.

D. Bronze Ball Valves, Two Piece with Full Port, and Bronze or Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

b. Milwaukee Valve Company.

c. NIBCO INC.

d. Viega LLC.

e. Zurn; Zurn Elkay.

2. Standard: MSS SP-110; IAPMO/ANSI Z1157.

3. CWP Rating: Minimum 200 psig (1380 kPa).

4. Body Design: Two piece.

5. Body Material: Bronze.

6. Ends: Press.

7. Press-End Connections Rating: Minimum 200 psig (1380 kPa).

8. Seats: PTFE or RTPFE.

9. Stem: Bronze or brass.

10. Ball: Chrome-plated brass.

11. Port: Full.

12. O-Ring Seal: EPDM or Buna-N.

E. Bronze Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

b. Milwaukee Valve Company.

c. NIBCO INC.

d. Viega LLC.

e. WATTS; A Watts Water Technologies Company.

2. Standard: MSS SP-110.

3. SWP Rating: 150 psig (1035 kPa).

4. CWP Rating: 600 psig (4140 kPa).

5. Body Design: Two piece.

6. Body Material: Bronze.

7. Ends: Threaded or soldered.

8. Seats: PTFE.

9. Stem: Stainless steel.

10. Ball: Stainless steel, vented.

11. Port: Full.

F. Bronze Ball Valves, Two Piece with Regular Port and Bronze or Brass Trim, Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

b. Milwaukee Valve Company.

c. NIBCO INC.

2. Standard: MSS SP-110.

3. SWP Rating: 150 psig (1035 kPa).

4. CWP Rating: 600 psig (4140 kPa).

5. Body Design: Two piece.

6. Body Material: Bronze.

7. Ends: Threaded.

8. Seats: PTFE.

9. Stem: Bronze.

10. Ball: Chrome-plated brass.

11. Port: Regular.

G. Bronze Ball Valves, Two Piece with Regular Port and Stainless Steel Trim, Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

b. Milwaukee Valve Company.

c. NIBCO INC.

d. Viega LLC.

2. Standard: MSS SP-110.

3. SWP Rating: 150 psig (1035 kPa).

4. CWP Rating: 600 psig (4140 kPa).

5. Body Design: Two piece.

6. Body Material: Bronze.

7. Ends: Threaded.

8. Seats: PTFE.

9. Stem: Stainless steel.

10. Ball: Stainless steel, vented.

11. Port: Regular.

H. Bronze Ball Valves, Three Piece with Regular Port and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

b. NIBCO INC.

2. Standard: MSS SP-110; MSS SP-145.

3. CWP Rating: 600 psig (4140 kPa).

4. Body Design: Three piece.

5. Body Material: Bronze.

6. Ends: Threaded.

7. Seats: PTFE.

8. Stem: Bronze.

9. Ball: Chrome-plated brass.

10. Port: Regular.

2.4 STAINLESS STEEL BALL VALVES

A. Stainless Steel Ball Valves, Two Piece with Full Port, Threaded or Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

b. Jomar Valve.

2. Standard: MSS SP-110.

3. CWP Rating: 200 psig (1380 kPa).

4. Body Design: Split body.

5. Body Material: Type 316 stainless steel.

6. Ends: Threaded or flanged.

7. Seats: PTFE.

8. Stem: Type 316 stainless steel.

9. Ball: Type 316 stainless steel.

10. Port: Full.

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. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.

B. Provide support of piping adjacent to valves such that no force is imposed upon valves.

C. Locate valves for easy access.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full valve actuation movement.

F. Valve Tags: Comply with requirements for valve tags and schedules.

G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

H. Adjust valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, provide the same types of valves with higher SWP classes or CWP ratings.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.

2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.

4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.

5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.

6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

7. For Stainless Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.

8. For Stainless Steel Piping,NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends.

3.4 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller: Brass or bronze ball valves, two piece with brass trim, full port, and threaded solder or press-connection-joint ends.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron ball valves, Class 125.

a. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

2. Steel ball valves, Class 150.

END OF SECTION 230523.12

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulation for HVAC piping systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 attachment and covering of heat tracing inside insulation.

3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

5. Detail removable insulation at piping specialties.

6. Detail application of field-applied jackets.

7. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material test reports.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program, certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified.

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.6 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.

    b. Owens Corning.

2. Preformed Pipe Insulation without Jacket: Type II, Class 1, unfaced.

3. Preformed Pipe Insulation with Jacket: Type II, Class 2, with factory-applied ASJ jacket.

4. Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.

5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F (minus 57 deg C) and 220 deg F (104 deg C). Comply with ASTM C534/C534M, Type I for tubular materials, Type II, for sheet materials.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

H. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F (454 deg C) in accordance with ASTM C411. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.

    b. Owens Corning.

2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ with factory-applied ASJ-SSL.

3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.

4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F (650 deg C) in accordance with ASTM C447. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.

    b. Owens Corning.

    c. ROCKWOOL.

2. Preformed Pipe Insulation: Type II, Grade A with factory-applied ASJ.
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.

J. Polyolefin: Polyethylene thermal plastic insulation. Comply with or ASTM C1427, Type I, Grade 1, for tubular materials and with Type II, Grade 1, for sheet materials, self-seal.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Owens Corning.

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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Owens Corning.

C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Owens Corning.

2. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.

3. Wet Flash Point: Below 0 deg F (minus 18 deg C).

4. Service Temperature Range: 40 to 200 deg F (4 to plus 93 deg C).

5. Color: Black.

D. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Owens Corning.

c. ROCKWOOL.

E. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Owens Corning.

c. ROCKWOOL.

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Owens Corning.

c. ROCKWOOL.

2.4 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Owens Corning.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.

3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

4. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.

5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Owens Corning.

2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm (0.66 metric perm) at manufacturer's recommended dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

4. Color: White.

2.5 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Owens Corning.

2. Permanently flexible, elastomeric sealant.

a. Service Temperature Range: Minus 150 to plus 250 deg F (Minus 101 to plus 121 deg C).

b. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Owens Corning.

2. Fire- and water-resistant, flexible, elastomeric sealant.

3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

4. Color: Aluminum.

D. ASJ Flashing Sealants and PVDC and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Owens Corning.

2. Fire- and water-resistant, flexible, elastomeric sealant.

3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

4. 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 C1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.

5. PSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Airex Manufacturing Inc.

b. Johns Manville; a Berkshire Hathaway company.

c. P.I.C. Plastics, Inc.

d. Proto Corporation.

e. Speedline Corporation.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: Color-code jackets based on system. Color as selected by Architect.

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.

D. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Speedline

2. Aluminum Jacket: Comply with ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.

b. Finish and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.

2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.

3) Tee covers.

4) Flange and union covers.

5) End caps.

6) Beveled collars.

7) Valve covers.

8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane, consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Owens Corning.

b. Polyguard Products, Inc.

F. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.

b. Foster Brand; H. B. Fuller.

c. Ideal Tape Co., Inc., an American Biltrite Company.

G. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket has five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.

b. Foster Brand; H. B. Fuller.

c. Ideal Tape Co., Inc., an American Biltrite Company.

2. Permeance: 0.00 perm as tested in accordance with ASTM F1249.

3. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.

4. Aluminum Finish: Smooth.

H. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested in accordance with ASTM E96/E96M and with a flame-spread index of 10 and a smoke-developed index of 20 when tested in accordance with ASTM E84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.

b. Foster Brand; H. B. Fuller.

c. Ideal Tape Co., Inc., an American Biltrite Company.

I. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm (0.007 metric perm) when tested in accordance with ASTM E96/E96M and with a flame-spread index of 25 and a smoke-developed index of 50 when tested in accordance with ASTM E84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.

b. Foster Brand; H. B. Fuller.

c. Ideal Tape Co., Inc., an American Biltrite Company.

J. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.

b. Foster Brand; H. B. Fuller.

c. Ideal Tape Co., Inc., an American Biltrite Company.

2.8 FIELD-APPLIED REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.

b. Foster Brand; H. B. Fuller.

c. Ideal Tape Co., Inc., an American Biltrite Company.

B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.

b. Foster Brand; H. B. Fuller.

c. Ideal Tape Co., Inc., an American Biltrite Company.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Building and Construction.

b. Foster Brand; H. B. Fuller.

c. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 3 inches (75 mm).

3. Thickness: 11.5 mils (0.29 mm).

4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

5. Elongation: 2

6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Owens Corning.

b. Polyguard Products, Inc.

2. Width: 3 inches (75 mm).

3. Thickness: 6.5 mils (0.16 mm).

4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Owens Corning.

b. Polyguard Products, Inc.

2. Width: 2 inches (50 mm).

3. Thickness: 6 mils (0.15 mm).

4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.

5. Elongation: 500 percent.

6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Owens Corning.

b. Polyguard Products, Inc.

2. Width: 2 inches (50 mm).

3. Thickness: 3.7 mils (0.093 mm).

4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.

5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Owens Corning.

    b. Polyguard Products, Inc.

2. Width: 3 inches (75 mm).

3. Film Thickness: 2 mils (0.05 mm).

4. Adhesive Thickness: 1.5 mils (0.04 mm).

5. Elongation at Break: 120 percent.

6. Tensile Strength: 20 psi (138 kPa) in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Owens Corning.

    b. Polyguard Products, Inc.

2. Width: 3 inches (75 mm).

3. Film Thickness: 6 mils (0.15 mm).

4. Adhesive Thickness: 1.5 mils (0.04 mm).

5. Elongation at Break: 145 percent.

6. Tensile Strength: 55 psi (379 kPa) in width.

2.10 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Owens Corning.

    b. Polyguard Products, Inc.

2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.

3. Aluminum: ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.

4. Springs: Twin spring set constructed of stainless steel, with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4 inch (19 mm) wide, stainless steel or Monel.

C. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman 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.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) 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 storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents, unless otherwise approved by the engineer of record.

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 attached to structure with vapor-barrier mastic.

3. Install insert materials and 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, but not to the extent of creating wrinkles or areas of compression in the insulation.

2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches (50 mm) o.c.

4. For below-ambient services, apply vapor-barrier mastic over staples.

5. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.

6. 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.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches in similar fashion 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.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).

4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies.

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using prefabricated fitting insulation or mitered or routed fittings made from same material and density as that of 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 prefabricated fitting insulation or sectional pipe insulation of same material and thickness as that 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 prefabricated fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 prefabricated fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining

pipe insulation by not less than 2 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, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.

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 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.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 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 (50 mm) 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.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.

4. For insulation with jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated 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 cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of cellular-glass insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of 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 sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.

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 prefabricated valve covers manufactured of same material as that of pipe insulation when available.

2. When prefabricated 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.

3.7 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.

4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated 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 glass-fiber or mineral-wool blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of 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 prefabricated sections of same material as that of straight segments of pipe insulation when available.

2. When prefabricated sections are not available, install fabricated 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.

3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive,or via self seal mechanism 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 polyolefin sheet insulation of same thickness as that of 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 polyolefin 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 cut sections of polyolefin pipe and sheet insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

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.

3.9 INSTALLATION OF FIELD-APPLIED JACKETS

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 (50-mm) overlap at seams and joints.

2. Embed glass cloth between two 0.062-inch- (1.6-mm-) 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) 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 and for horizontal applications, install with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches (300 mm) o.c. and at end joints.

E. 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 presized jackets around individual pipe insulation sections, with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.

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 (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use 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. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.11 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

E. All insulation applications will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. 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.

C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Underground piping.

2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 1 inch (25 mm) thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 1/2 inch (13 mm) thick.

e. Polyolefin: 1 inch (25 mm) thick.

B. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and Below:

1. NPS 12 (DN 300) and Smaller: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Glass-Fiber, Preformed Pipe, Type I: 1 inch (25 mm) thick.

c. Mineral Wool, Preformed Pipe, Type II: 1 inch (25 mm) thick.

2. NPS 14 (DN 350) and Larger: Insulation shall be one of the following:

a. Cellular Glass: 2 inches (50 mm) thick.

b. Glass-Fiber, Preformed Pipe Insulation, Type 1: 1-1/2 inches (38 mm) thick.

c. Mineral Wool, Preformed Pipe Insuation, Type II or Pipe and Tank Insulation: 1-1/2 inches (38 mm) thick.

C. Heating-Hot-Water Supply and Return, Above 200 Deg F (93 Deg C):

1. NPS 3/4 (DN 20) and Smaller: Insulation shall be one of the following:

a. Cellular Glass: 2 inches (50 mm) thick.

b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches (38 mm) thick.

c. Mineral Wool, Preformed Pipe Insulation, Type II: 1-1/2 inches (38 mm) thick.

2. NPS 1 (DN 25) and Larger: Insulation shall be one of the following:

a. Cellular Glass: 3 inches (75 mm) thick.

b. Glass-Fiber, Preformed Pipe, Type I: 3 inches (75 mm) thick.

c. Mineral Wool, Preformed Pipe, Type II: 3 inches (75 mm) thick.

D. Steam and Steam Condensate, Boiler Blowdown, Vents, Drains, and Safety Relief Vents 350 Deg F (177 Deg C) and Below:

1. NPS 3/4 (DN 20) and Smaller: Insulation shall be one of the following:

a. Cellular Glass: 2 inches (50 mm) thick.

b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches (38 mm) thick.

c. Mineral Wool, Preformed Pipe Insulation, Type II: 1-1/2 inches (38 mm) thick.

2. NPS 1 (DN 25) and Larger: Insulation shall be one of the following:

a. Cellular Glass: 3 inches (75 mm) thick.

b. Glass-Fiber, Preformed Pipe Insulation, Type I: 3 inches (75 mm) thick.

c. Mineral Wool, Preformed Pipe Insulation, Type II or Pipe and Tank Insulation: 3 inches (75 mm) thick.

E. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 1 inch (25 mm) thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.

e. Polyolefin: 1 inch (25 mm) thick.

F. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 2 inches (50 mm) thick.

b. Polyolefin: 2 inches (50 mm) thick.

G. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 1 inch (25 mm) thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.

e. Polyolefin: 1 inch (25 mm) thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 2 inches (50 mm) thick.

b. Flexible Elastomeric: 2 inches (50 mm) thick.

c. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.

d. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches (50 mm) thick.

e. Polyolefin: 2 inches (50 mm) thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation is the following:

a. Flexible Elastomeric: 2 inches (50 mm) thick.

C. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch (25 mm) thick.

b. Polyolefin: 1 inch (25 mm) thick.

3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

2. PVC: 30 mils (0.8 mm) thick.

3. Aluminum, Smooth: 0.032 inch (0.81 mm) thick.

4. Painted Aluminum, Smooth: 0.032 inch (0.81 mm) thick.

D. Piping, Exposed:

1. None.

2. PVC: 30 mils (0.8 mm) thick.

3. Aluminum, Smooth: 0.032 inch (0.81 mm) thick.

4. Painted Aluminum, Smooth: 0.032 inch (0.81 mm) thick.

END OF SECTION 230719

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

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 and vibration isolation.

C. Delegated Design Submittals:

1. Sheet metal thicknesses.

2. Joint and seam construction and sealing.

3. Reinforcement details and spacing.

4. Materials, fabrication, assembly, and spacing of hangers and supports.

5. Design Calculations: Calculations for selecting hangers and supports.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Welding certificates.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.

3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Mockups:

1. Before installing duct systems, build mockups representing static-pressure classes in excess of 3 inch wg. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

a. Five transverse joints.

b. One access door(s).

c. Two typical branch connections, each with at least one elbow.

d. Two typical flexible duct or flexible-connector connections for each duct and apparatus.

e. One 90-degree turn(s) with turning vanes.

f. One fire damper(s).

g. One smoke damper(s).

h. Perform leakage tests specified in "Field Quality Control" Article. Revise mockup construction and perform additional tests as required to achieve specified minimum acceptable results.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 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.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.

2. For ducts exposed to weather, construct of Type 304 Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.

2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

3. Where specified for specific applications, all joints are to be welded.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams are to be Pittsburgh lock seams unless otherwise specified for specific application.

1. Where specified for specific applications, all joints are to be welded.

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.

2. For ducts exposed to weather, construct of Type 304 Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elgen Manufacturing.

b. GreenSeam.

c. Linx Industries; a DMI company (formerly Lindab).

d. MKT Metal Manufacturing.

e. McGill AirFlow LLC.

f. Nordfab Ducting.

g. SEMCO, LLC; part of FlaktGroup.

h. SHAPE Manufacturing Inc.

i. Set Duct Manufacturing.

j. Sheet Metal Connectors, Inc.

k. Spiral Manufacturing Co., Inc.

B. Source Limitations: Obtain single-wall round and flat oval ducts and fittings from single manufacturer.

C. 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).

D. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

E. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

F. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 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 are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

C. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.

D. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish is to be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating is to be applied to the exterior surface.

2. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Coating containing the antimicrobial compound is to have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.

4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

5. Shop-Applied Coating Color: White.

6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

G. Reinforcement Shapes and Plates: ASTM A36/A36M, 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.

H. 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 C1071, 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; SAINT-GOBAIN.

b. Johns Manville; a Berkshire Hathaway company.

c. Knauf Insulation.

d. Manson Insulation Inc.

e. Owens Corning.

2. Source Limitations: Obtain fibrous-glass duct liner from single manufacturer.

3. 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 at 75 deg F mean temperature.

4. 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 is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

5. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.

a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, 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.

b. Armacell LLC.

c. Rubatex International, LLC.

2. Source Limitations: Obtain flexible elastomeric duct liner from single manufacturer.

3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile

Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Fibrous-Glass-Free, Natural-Fiber Duct Liner: Made from partially recycled cotton or polyester products and containing no fiberglass. Airstream surface overlaid with fire-resistant facing to prevent surface erosion by airstream, complying with NFPA 90A or NFPA 90B. Treat natural-fiber products with antimicrobial coating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acoustical Surfaces, Inc.

   b. Ductmate Industries, Inc; a DMI company.

2. Source Limitations: Obtain fibrous-glass-free, natural-fiber duct liner from single manufacturer.

3. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested in accordance with ASTM C518.

4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with ASTM E84; certified by an NRTL.

5. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

D. Polyolefin Duct Liner: Cross-linked, partially open-cell polyolefin foam sheet or roll materials, with reinforced aluminum foil facing and adhesive backing, complying with NFPA 90A or NFPA 90B; sheet (Type II) complying with ASTM C1427.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Sekisui Voltek, LLC.

2. Source Limitations: Obtain polyolefin duct liner from single manufacturer.

3. Foam Core Density: 1.5 pcf.

4. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested in accordance with ASTM C518.

5. Minimum Noise Reduction Coefficient (NRC): 0.50 for3/8-inch thickness, 0.45 for 5/8-inch thickness, 0.55 for 1-inch thickness, 0.55 for 2-1/8-inch thickness.

6. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

7. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

E. Insulation Pins and Washers:

1. 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.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick stainless steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.

F. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.

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 are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with 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 (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.

2. Solids Content: Minimum 65 percent.

3. Shore A Hardness: Minimum 20.

4. Water resistant.

5. Mold and mildew resistant.

6. VOC: Maximum 75 g/L (less water).

7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.

8. Service: Indoor or outdoor.

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.

2. Base: Synthetic rubber resin.

3. Solvent: Toluene and heptane.

4. Solids Content: Minimum 60 percent.

5. Shore A Hardness: Minimum 60.

6. Water resistant.

7. Mold and mildew resistant.

8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.

9. Service: Indoor or outdoor.

10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.

2. Type: S.

3. Grade: NS.

4. Class: 25.

5. Use: O.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for10-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: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.

F. Steel Cable End Connections: Galvanized-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.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. 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.

J. Install fire and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.

2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

N. Branch Connections: Use lateral or conical branch connections.

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 arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCT

A. Install ducts in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operation"; SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" unless otherwise indicated.

B. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

C. All ducts exposed to view are to be constructed of stainless steel as per "Duct Schedule" Article. All ducts concealed from view are to be stainless steel as per "Duct Schedule" Article.

D. All joints are to be welded and are to be telescoping, bell, or flange joint as per NFPA 96.

E. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.

F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR EXHAUST DUCTS SERVING COMMERCIAL DISHWASHERS AND OTHER HIGH-HUMIDITY LOCATIONS

A. Install dishwasher exhaust ducts and other exhaust ducts from wet, high-humidity locations without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to dishwasher or toward drain.

B. Provide a drain pocket at each low point and at the base of each riser with a 1-inch trapped copper drain from each drain pocket to open site floor drain.

C. Minimize number of transverse seams.

D. Do not locate longitudinal seams on bottom of duct.

3.5 ADDITIONAL INSTALLATION REQUIREMENTS FOR LABORATORY EXHAUST AND FUME HOOD EXHAUST DUCTS

A. Install ducts in accordance with NFPA 45, "Fire Protection for Laboratories Using Chemicals."

B. Install exhaust ducts without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to hood or inlet. Where indicated on Drawings, install trapped drain piping.

C. Connect duct to fan, fume hood, and other equipment indicated on Drawings.

3.6 DUCTWORK EXPOSED TO WEATHER

A. All external joints are to be welded. Seal all openings to provide weatherproof construction.

B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

C. Single Wall:

1. Ductwork is to be Type 304 or Type 316 stainless steel.

2. Ductwork is to be galvanized steel.

a. If duct outer surface is uninsulated, protect outer surface with suitable paint.

3. Where ducts have external insulation, provide weatherproof aluminum jacket.

D. Double Wall:

1. Ductwork outer wall is to be Type 304 or Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

2. Provide interstitial insulation.

3.7 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2. Outdoor, Supply-Air Ducts: Seal Class A.

3. Outdoor, Exhaust Ducts: Seal Class C.

4. Outdoor, Return-Air Ducts: Seal Class C.

5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg 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.

3.8 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum 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.

3.9 DUCTWORK CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.10 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099123 "Interior Painting."

3.11 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- 3- 4- Insert number Inch wg or Higher: Test representative duct sections 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- 3- 4- 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- 3- 4- Insert number Inch wg or Higher: Test representative duct sections 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- 3- 4- 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. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.

5. Test for leaks before applying external insulation.

6. 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.

7. 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 in accordance with "Description of Method 3 - NADCA 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 is to not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.12 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."

C. Use duct cleaning methodology as indicated in NADCA ACR.

D. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "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.

E. 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.

F. 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.

G. 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 in accordance with NADCA ACR. 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 in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.13 STARTUP

A. Air Balance: Comply with requirements.

3.14 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive 1- 2 inch wg.

b. Minimum SMACNA Seal Class: C.

c. SMACNA Leakage Class for Rectangular: 4.

d. SMACNA Leakage Class for Round and Flat Oval: 4.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 2- 4-inch wg.

b. Minimum SMACNA Seal Class: C.

c. SMACNA Leakage Class for Rectangular: 4.

d. SMACNA Leakage Class for Round and Flat Oval: 4.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units

a. Pressure Class: Positive or negative 1- 2inch wg.

b. Minimum SMACNA Seal Class: C.

c. SMACNA Leakage Class for Rectangular: 4.

d. SMACNA Leakage Class for Round and Flat Oval: 4.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.

b. Minimum SMACNA Seal Class: C.

c. SMACNA Leakage Class for Rectangular: 4.

d. SMACNA Leakage Class for Round and Flat Oval: 4.

3. Ducts Connected to Equipment Not Listed above:

a. Pressure Class: Positive or negative 2- 4-inch wg.

b. Minimum SMACNA Seal Class: C.

c. SMACNA Leakage Class for Rectangular: 4.

d. SMACNA Leakage Class for Round and Flat Oval: 4.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 1-inch wg.

b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.

c. SMACNA Leakage Class for Rectangular: 4.

d. SMACNA Leakage Class for Round and Flat Oval: 4.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.

b. Minimum SMACNA Seal Class: C if negative pressure, and C if positive pressure.

c. SMACNA Leakage Class for Rectangular: 4.

d. SMACNA Leakage Class for Round and Flat Oval: 4.

3. Ducts Connected to Equipment Not Listed above:

a. Pressure Class: Positive or negative 2-inch wg.

b. Minimum SMACNA Seal Class: A if negative pressure; A if positive pressure.

c. SMACNA Leakage Class for Rectangular: 4.

d. SMACNA Leakage Class for Round and Flat Oval: 4.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 1- 2-inch wg.

b. Minimum SMACNA Seal Class: C.

c. SMACNA Leakage Class for Rectangular: 8.

d. SMACNA Leakage Class for Round and Flat Oval: 8.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.

b. Minimum SMACNA Seal Class: A.

c. SMACNA Leakage Class for Rectangular: 4.

d. SMACNA Leakage Class for Round and Flat Oval: 4.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2- 4-inch wg.

b. Minimum SMACNA Seal Class: A.

c. SMACNA Leakage Class for Rectangular: 4.

d. SMACNA Leakage Class for Round and Flat Oval: 4.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel Galvanized steel or carbon steel coated with zinc-chromate primer.

2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.

b. Not Exposed to Airstream: Match duct material.

3. Stainless Steel Ducts:

a. Exposed to Airstream: Match duct material.

b. Not Exposed to Airstream: Match duct material.

4. Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

G. Liner:

1. Supply-Air Ducts: Fibrous glass, Type I Flexible elastomeric Fibrous-glass-free, natural fiber, 1 inch thick.

2. Return-Air Ducts: Fibrous glass, Type I Flexible elastomeric Fibrous-glass-free, natural fiber, 1 inch thick..

3. Exhaust-Air Ducts Fibrous glass, Type I Flexible elastomeric Fibrous-glass-free, natural fiber, 1 inch thick..

H. Elbow Configuration:

1. Rectangular Duct - Requirements for Different Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.

2) Mitered Type RE 4 without vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.

2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.

3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.

2) Velocity 1000 to 1500 fpm: 1.0 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: Standing seam.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.

b. Rectangular Main to Round Branch: Conical spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.

b. Velocity 1000 to 1500 fpm: Conical tap.

c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Flange connectors.
4. Turning vanes.
5. Duct-mounted access doors.
6. Duct access panel assemblies.
7. Flexible connectors.
8. Duct accessory hardware.

B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop, dynamic insertion loss, and self-generated noise data. Include breakout noise calculations for high-transmission-loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.

b. Manual volume damper installations.

c. Control-damper installations.

d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

e. Duct security bars.

f. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Source quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 90A and NFPA 90B.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ruskin; Air Distribution Technologies, Inc.

2. Greenheck Fan Corporation.

3. Lloyd Industries, Inc.

4. Pottorff.

B. Description: Gravity balanced.

C. Performance:

1. Maximum Air Velocity: 1000 fpm (5.1 m/s).

2. Maximum System Pressure: 1 inch wg (0.25 kPa).

3. AMCA Certification: Test and rate in accordance with AMCA 511.

4. Leakage:

   a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. (15.2 L/s per sq. m) against 1-inch wg (250-Pa) differential static pressure.

   b. Class I: Leakage shall not exceed 4 cfm/sq. ft. (20 L/s per sq. m) against 1-inch wg (250-Pa) differential static pressure.

   c. Class II: Leakage shall not exceed 10 cfm/sq. ft. (51 L/s per sq. m) against 1-inch wg (250-Pa) differential static pressure.

   d. Class III: Leakage shall not exceed 40 cfm/sq. ft. (203 L/s per sq. m) against 1-inch wg (250-Pa) differential static pressure.

D. Construction:

1. Frame:

   a. Hat shaped.

   b. 16-gauge- (1.6-mm-) thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.

2. Blades:

   a. Multiple single-piece blades.

   b. Center pivoted, maximum 6-inch (150-mm) width, 16-gauge- (1.6-mm-) thick, galvanized sheet steel 26-gauge (0.48-mm) Type 304 stainless steel noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges.

3. Blade Action: Parallel.

E. Blade Seals: Vinyl foam.

F. Blade Axles:

1. Material: Nonferrous metal Galvanized steel Aluminum.

2. Diameter: 0.20 inch (5 mm).

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

I. Bearings: Steel ball.

J. Damper Actuator - Electric:

1. Electric - 120 V ac.

2. UL 873 plenum rated.

3. Fully modulating.

   a. Sufficient motor torque and spring torque to drive damper fully closed with adequate force to achieve required damper seal.

   b. Minimum 90-degree drive rotation.

4. Clockwise or counterclockwise drive rotation as required for application.

5. Environmental Operating Range:

   a. Temperature: Minus 40 to plus 130 deg F (Minus 40 to plus 55 deg C).

   b. Humidity: 5 to 95 percent relative humidity noncondensing.

6. Environmental Enclosure: NEMA 2.

7. Actuator to be factory mounted and provided with a single-point wiring connection.

K. Damper Actuator - Pneumatic:

1. Operated by 0 to 20 psig (0 to 138 kPa) pneumatic signal.

2. Fully modulating with positioner and fail-safe spring return.

   a. Sufficient power and spring force to drive damper fully closed with adequate force to achieve required damper seal.

   b. Maximum 15-second full-stroke closure.

3. Actuator to be factory mounted.

L. Controllers, Electrical Devices, and Wiring:

1. Comply with requirements for electrical devices and connections.

2. Electrical Connection: .

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.

2. Counterweights and spring-assist kits for vertical airflow installations.

3. Chain pulls.

4. Screen Mounting:

    a. Front mounted in sleeve.

        1) Sleeve Thickness: 20 gauge (1.0 mm) minimum.

        2) Sleeve Length: 6 inches (150 mm) minimum.

5. Screen Material: Galvanized steel.

6. Screen Type: Insect.

7. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Air Balance; MESTEK, Inc.

    b. Aire Technologies, Inc.; DMI Companies.

    c. American Warming and Ventilating (AWV); Mestek, Inc.

    d. Arrow United Industries; Mestek, Inc.

    e. Cesco Products; MESTEK, Inc.

    f. Greenheck Fan Corporation.

    g. Lloyd Industries, Inc.

    h. McGill AirFlow LLC.

    i. NCA Manufacturing, Inc.; Metal Industries, Inc.

    j. Nailor Industries Inc.

    k. Pottorff.

2. Performance:

    a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. (203 L/s per sq. m) against 1-inch wg (250-Pa) differential static pressure.

3. Construction:

    a. Linkage out of airstream.

b. Suitable for horizontal or vertical airflow applications.

4. Frames:

a. Hat-shaped, 16-gauge- (1.6-mm-) thick, galvanized sheet steel.

b. Mitered and welded corners.

c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.

b. Parallel- or opposed-blade design.

c. Stiffen damper blades for stability.

d. Galvanized steel; 16 gauge (1.6 mm) thick.

6. Blade Axles: Galvanized steel.

7. Bearings:

a. Oil-impregnated bronze.

b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

8. Tie Bars and Brackets: Galvanized steel.

9. Locking device to hold damper blades in a fixed position without vibration.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ruskin; Air Distribution Technologies, Inc.

b. American Warming and Ventilating (AWV); Mestek, Inc.

c. Arrow United Industries; Mestek, Inc.

d. Cesco Products; MESTEK, Inc.

e. Linx Industries; a DMI company (formerly Lindab).

f. Nailor Industries Inc.

g. Pottorff.

h. Safe Air - Dowco.

i. United Enertech Corp.

2. Performance:

a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. (203 L/s per sq. m) against 1-inch wg (250-Pa) differential static pressure.

3. Construction:

a. Linkage out of airstream.

b. Suitable for horizontal or vertical airflow applications.

4. Frames:

a. Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels.

b. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.

b. Parallel- or opposed-blade design.

c. Stiffen damper blades for stability.

d. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.

e. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.

6. Blade Axles: Galvanized steel.

7. Bearings:

a. Oil-impregnated bronze.

b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

8. Tie Bars and Brackets: Aluminum.

9. Locking device to hold damper blades in a fixed position without vibration.

C. Jackshaft:

1. Size: 0.5-inch (13-mm) diameter.

2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.

2. Include center hole to suit damper operating-rod size.

3. Include elevated platform for insulated duct mounting.

2.4 FLANGE CONNECTORS

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gauge and Shape: Match connecting ductwork.

2.5 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aero-Dyne Sound Control Co.

2. CL WARD & Family Inc.

3. Ductmate Industries, Inc; a DMI company.

4. Duro Dyne Inc.

5. DynAir; a Carlisle Company.

6. Elgen Manufacturing.

7. Ward Industries; a brand of Hart & Cooley, LLC.

B. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

E. Vane Construction:

1. Single wall.

2. Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.6 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ruskin; Air Distribution Technologies, Inc.

2. Aire Technologies, Inc.; DMI Companies.

3. Arrow United Industries; Mestek, Inc.

4. CL WARD & Family Inc.

5. Cesco Products; MESTEK, Inc.

6. Ductmate Industries, Inc; a DMI company.

7. Duro Dyne Inc.

8. Elgen Manufacturing.

9. Flexmaster U.S.A., Inc.

10. McGill AirFlow LLC.

B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.

b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.

c. 24-gauge- (0.70-mm-) thick galvanized steel door panel.

d. Vision panel.

e. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

f. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

a. 24-gauge- (0.70-mm-) thick galvanized steel or 0.032-inch- (0.81-mm-) thick aluminum frame.

3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.

b. Access Doors up to 18 Inches (460 mm) Square: and two sash locks.

c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges Continuous and two compression latches with outside and inside handles.

d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges Continuous and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.

a. 24-gauge- (0.70-mm-) thick galvanized steel door panel.

2. Door: Single wall with metal thickness applicable for duct pressure class.

3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.

4. Factory set at 3.0 to 8.0 inches wg (800 to 2000 Pa).

5. Doors close when pressures are within set-point range.

6. Hinge: Continuous piano.

7. Latches: Cam.

8. Seal: Neoprene or foam rubber.

9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.7 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc; a DMI company.
3. Flame Gard, Inc.

B. Access panels used in cooking applications:

1. Labeled compliant to NFPA 96 for grease duct access doors.
2. Labeled in accordance with UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 16-gauge (1.6-mm) carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96, grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

F. Minimum Pressure Rating: 10 inches wg (2500 Pa) positive or negative.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc; a DMI company.
3. Duro Dyne Inc.
4. DynAir; a Carlisle Company.
5. Elgen Manufacturing.
6. Ventfabrics, Inc.
7. Ward Industries; a brand of Hart & Cooley, LLC.

B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Materials: Flame-retardant or noncombustible fabrics.

E. Coatings and Adhesives: Comply with UL 181, Class 1.

F. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

G. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).

2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.

3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

H. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).

2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.

3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

I. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd. (542 g/sq. m).

2. Tensile Strength: 285 lbf/inch (50 N/mm) in the warp and 185 lbf/inch (32 N/mm) in the filling.

3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

J. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd. (474 g/sq. m).

2. Tensile Strength: 450 lbf/inch (79 N/mm) in the warp and 340 lbf/inch (60 N/mm) in the filling.

3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

K. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.9 DUCT ACCESSORY HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD & Family Inc.

2. Ductmate Industries, Inc; a DMI company.

3. Duro Dyne Inc.

4. DynAir; a Carlisle Company.

5. Elgen Manufacturing.

6. Hardcast; Carlisle Construction Materials.

7. United Enertech Corp.

8. Ventfabrics, Inc.

9. Ward Industries; a brand of Hart & Cooley, LLC.

B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.10 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G60 (Z180).

2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B209 (ASTM B209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B221 (ASTM B221M), 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 (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.

E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

2. Install aluminum volume dampers in aluminum ducts.

F. Set dampers to fully open position before testing, adjusting, and balancing.

G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.

2. Upstream and downstream from duct filters.

3. At outdoor-air intakes and mixed-air plenums.

4. At drain pans and seals.

5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.

6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

7. At each change in direction and at maximum 50-ft. (15-m) spacing.

8. Upstream and downstream from turning vanes.

9. For grease ducts, install at locations and spacing as required by NFPA 96.

10. Control devices requiring inspection.

11. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).

2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).

3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).

4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).

5. Body Access: 25 by 14 inches (635 by 355 mm).

6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

K. Label access doors to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5 inches wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Install duct test holes where required for testing and balancing purposes.

O. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.

2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.

3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.

4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.

5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flexible ducts, noninsulated.
2. Flexible ducts, insulated.
3. Flexible duct connectors.

1.2 ACTION SUBMITTALS

A. Product data.

B. Product Data Submittals: For each type of product.

C. Shop Drawings: For flexible ducts.

1. Include plans showing locations, mounting details, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A and NFPA 90B.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials must be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Comply with the Air Duct Council's (formerly, Air Diffusion Council) "ADC Flexible Air Duct Test Code - FD 72-R1" and "Flexible Duct Performance & Installation Standards."

D. Comply with ASTM E96/E96M.

2.2 FLEXIBLE DUCTS, NONINSULATED

A. Standard: Product is to be UL 181 listed and bearing the UL label.

B. Flexible Ducts, Noninsulated - Class 1, Two-Ply Vinyl or Polyethylene Film Supported by Helically Wound, Spring-Steel Wire:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flexmaster U.S.A., Inc.

b. JP Lamborn Co.

c. Thermaflex; a Flex-Tek Group company.

2. Pressure Rating: 10 inch wg (2500 Pa) positive and 1.0 inch wg (250 Pa) negative.

3. Maximum Air Velocity: 4000 fpm (20 m/s).

4. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

C. Flexible Ducts, Noninsulated - Class 1, Multiple Layers of Aluminum Laminate Supported by Helically Wound, Spring-Steel Wire:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Flexmaster U.S.A., Inc.

2. Pressure Rating: 10 inch wg (2500 Pa) positive and 1.0 inch wg (250 Pa) negative.

3. Maximum Air Velocity: 4000 fpm (20 m/s).

4. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).

D. Flexible Ducts, Noninsulated - Class 0, Interlocking Spiral of Aluminum Foil:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ATCO Rubber Products, Inc.

b. Flexmaster U.S.A., Inc.

2. Pressure Rating: 8 inch wg (2280 Pa) positive or negative.

3. Maximum Air Velocity: 5000 fpm (25 m/s).

4. Temperature Range: Minus 100 to plus 435 deg F (Minus 73 to plus 224 deg C).

2.3 FLEXIBLE DUCTS, INSULATED

A. Standard: Product is to be UL 181 listed and bearing the UL label.

B. Flexible Ducts, Insulated - Class 1, Two-Ply Vinyl Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ATCO Rubber Products, Inc.

b. Flexmaster U.S.A., Inc.

c. JP Lamborn Co.

d. Thermaflex; a Flex-Tek Group company.

2. Pressure Rating: 10 inch wg (2500 Pa) positive and 1.0 inch wg (250 Pa) negative.

3. Maximum Air Velocity: 4000 fpm (20 m/s).

4. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

5. Insulation R-Value: Comply with ASHRAE/IES 90.1.

6. Vapor-Barrier Film: Polyethylene.

C. Flexible Ducts, Insulated - Class 1, Multiple Layers of Aluminum Laminate Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flexmaster U.S.A., Inc.

b. JP Lamborn Co.

c. Thermaflex; a Flex-Tek Group company.

2. Pressure Rating: 10 inch wg (2500 Pa) positive and 1.0 inch wg (250 Pa) negative.

3. Maximum Air Velocity: 4000 fpm (20 m/s).

4. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).

5. Insulation R-Value: Comply with ASHRAE/IES 90.1.

6. Vapor-Barrier Film: Polyethylene.

2.4 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless steel band with stainless steel or zinc-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

B. Non-Clamp Connectors: Adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.1 INSTALLATION OF FLEXIBLE DUCTS

A. Install flexible ducts in accordance with applicable details in the following publications:

1. ADC's "Flexible Duct Performance & Installation Standards" for flexible ducts.

2. NAIMA AH116.

3. SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

4. SMACNA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.

B. Install in indoor applications only. Do not install flexible duct in locations where it will be exposed to UV lighting.

C. Connect terminal units to supply ducts directly or with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.

D. Connect diffusers and light troffer boots to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

E. Connect flexible ducts to metal ducts with draw bands adhesive plus sheet metal screws.

F. Installation:

1. Install ducts fully extended.

2. Do not bend ducts across sharp corners.

3. Bends of flexible ducting must not exceed a minimum of one-duct diameter.

4. Avoid contact with metal fixtures, water lines, pipes, or conduits.

5. Install flexible ducts in a direct line, without sags, twists, or turns.

6. Install in accordance with ADC instructions.

G. Supporting Flexible Ducts:

1. Support flexible duct at manufacturer's recommended intervals, but at no greater distance than 4 ft. (1.2 m). Provide sufficient support so that maximum centerline sag is 1/2 in. per

ft. (42 mm per meter) between supports. A connection to rigid duct or equipment may be considered a support joint.

2. Install extra supports at bends placed approximately one-duct diameter from center line of the bend.

3. Ducts may rest on ceiling joists or truss supports. Spacing between supports must not exceed the maximum spacing in accordance with manufacturer's written installation instructions.

4. Vertically installed ducts must be stabilized by support straps at a maximum of 72 inches (1800 mm) o.c.

END OF SECTION 233346

SECTION 233713.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed face registers and grilles.

B. Related Requirements:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 REGISTERS

A. Fixed Face Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A-J Manufacturing Co., Inc.

b. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.

c. Carnes Company.

d. Dayus Register & Grille Inc.

e. Hart & Cooley, LLC.

f. Kees, Inc.

g. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.

h. METALAIRE, Inc.

i. Nailor Industries Inc.

j. Price Industries Limited.

k. Raymon Company.

2. Material: Aluminum.

3. Finish: Baked enamel, color selected by Architect.

4. Face Blade Arrangement: Horizontal spaced 1/2 inch (13 mm) apart.

5. Face Arrangement: Perforated core.

6. Core Construction: Integral.

7. Frame: 1 inch (25 mm) wide.

8. Mounting Frame: Filter.

9. Mounting: Lay in.

10. Damper Type: Adjustable opposed blade.

11. Accessory: Filter.

2.2 GRILLES

A. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A-J Manufacturing Co., Inc.

b. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.

c. Bauco Access Panel Solutions Inc.

d. Carnes Company.

e. Dayus Register & Grille Inc.

f. Hart & Cooley, LLC.

g. Kees, Inc.

h. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.

i. METALAIRE, Inc.

j. Nailor Industries Inc.

k. Price Industries Limited.

2. Material: Aluminum.

3. Finish: Baked enamel, color selected by Architect.

4. Face Blade Arrangement: Horizontal; spaced 1/2 inch (13 mm) apart.

5. Face Arrangement: Perforated core.

6. Core Construction: Integral.

7. Frame: 1 inch (25 mm) wide.

8. Mounting Frame: Filter.

9. Mounting: Lay in.

10. Accessory: Filter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

SECTION 238113.11 - PACKAGED TERMINAL AIR-CONDITIONERS, THROUGH-WALL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Packaged, terminal air-conditioners, through-wall units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For packaged, terminal air conditioners.

1. Include plans, elevations, sections, details for wall penetrations, and attachments to other work.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

C. Color Samples: For unit cabinet, discharge grille, and exterior louver, and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, terminal air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Sealed Refrigeration System: Manufacturer's standard, but not less than five years from date of Substantial Completion, including components and labor.

2. Warranty Period for Nonsealed System Parts: Manufacturer's standard, but not less than five years from date of Substantial Completion, including only components and excluding labor.

PART 2 - PRODUCTS

2.1 PACKAGED, TERMINAL AIR-CONDITIONERS, THROUGH-WALL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amana; Whirlpool Corporation.
2. ClimateMaster, Inc.
3. Comfort-Aire; a division of Heat Controller, Inc.
4. Friedrich Air Conditioning Company.
5. GE Appliances; Haier Group.
6. Ice Air LLC.
7. LG Electronics USA, Inc.; LG Electronics Inc.
8. Suburban Manufacturing Company; a division of AIRXCEL, Inc.

B. Manufactured Units:

1. Description: Factory-assembled and -tested, self-contained, packaged, terminal air conditioner with room cabinet, electric refrigeration system, heating, and temperature controls; fully charged with refrigerant and filled with oil; with cord-connected chassis.
2. 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.
3. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."
4. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

C. Chassis:

1. Cabinet: 0.052-inch- (1.3-mm-) thick galvanized steel with removable front panel with concealed latches.
    a. Mounting: Wall with wall sleeve.
    b. Top: Angled.
    c. Discharge Grille: Extruded-aluminum discharge grille, tamperproof, and carrying a flame test rating in accordance with UL 94.
    d. Louvers: Extruded aluminum with enamel finish; white color.

e. Finish: Baked enamel.

f. Access Door: Hinged door in top of cabinet for access to controls.

g. Cabinet Extension: Matching cabinet in construction and finish, allowing diversion of airflow to adjoining room; with grille.

h. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

i. Subbase: Enameled steel with adjustable leveling feet and adjustable end plates, with factory-installed and -wired, fused disconnect switch and receptacle sized for unit.

j. Wall Sleeves: Galvanized steel with polyester finish.

2. Refrigeration System: Direct-expansion indoor coil with capillary restrictor and hermetically sealed scroll compressor with vibration isolation and overload protection.

a. Indoor and Outdoor Coils: Seamless copper tubes mechanically expanded into aluminum fins with capillary tube distributor on indoor coil.

b. Accumulator.

c. Constant-pressure expansion valve.

d. Reversing valve.

e. Charge: R-410A.

3. Indoor Fan: Forward curved, centrifugal; with motor and positive-pressure ventilation damper with concealed manual operator.
4. Filters: Washable polyurethane in molded plastic frame.
5. Condensate Drain: Drain pan and piping to direct condensate to building waste and vent piping.

a. Comply with ASHRAE 62.1 for drain pan construction and connections.

6. Outdoor Fan: Forward curved, centrifugal type driven by indoor fan motor.

a. Indoor and Outdoor Fan Motors: Two speed; comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230500 "Common Work Results for HVAC."

1) Fan Motors: Permanently lubricated split capacitor.

2) 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.

3) Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

D. Heating:

1. Electric-Resistance Heating Coil: Nickel-chromium-wire, electric-resistance heating elements with contactor and high-temperature-limit switch.

E. Controls:

1. Control Module: Unit-mounted digital panel with touchpad temperature control and with touchpad for heating, cooling, and fan operation. Include the following features:

a. Low-Ambient Lockout Control: Prevents cooling-cycle operation below 40 deg F (5 deg C) outdoor air temperature.

b. Heat-Pump Ambient Control: Field-adjustable switch changes to heat-pump heating operation above 40 deg F (5 deg C) and to supplemental heating below plus 25 deg F (minus 4 deg C).

c. Temperature-Limit Control: Prevents occupant from exceeding preset setback or setup temperature.

d. Reverse-Cycle Defrost: Solid-state sensor monitors frost buildup on outdoor coil and reverses unit to melt frost.

2. Remote Control: Standard unit-mounted controls with remote-mounted, low-voltage, adjustable thermostat with heat anticipator; switch; and on-auto fan switch.

3. Outdoor Air:

a. Motorized intake damper. Open intake when unit indoor-air fan runs.

b. Manual intake damper.

2.2 CAPACITIES AND CHARACTERISTICS

A. Airflow: 310 cfm:.

B. Cooling Capacity:

1. Total: 11.8

2. Sensible: 9.8

3. Energy-Efficiency Ratio: 9.8

C. Electrical Characteristics:

1. Volts: 120

2. Phase: Single.

3. Hertz: 60.

2.3 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Factory test to comply with AHRI 300, "Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment."

B. Unit Performance Ratings: Factory test to comply with AHRI 310/380/CSA C744, "Packaged Terminal Air-Conditioners and Heat Pumps."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.

B. Install wall sleeves in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."

C. Install and anchor wall sleeves to withstand, without damage to equipment and structure, seismic forces required by building code.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.

2. After installing packaged, terminal air conditioners and after electrical circuitry has been energized, test for compliance with requirements.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Packaged, terminal air conditioners will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 238113.11

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Split-system air-conditioners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

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.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.

b. For Parts: Five year(s) from date of Substantial Completion.

c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SPLIT-SYSTEM AIR-CONDITIONERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Global Corporation.

2. Coleman Company Inc. (The).

3. First Operations LP.

4. Friedrich Air Conditioning Company.

5. Goodman; a member of Daiken Group.

6. Lennox.

7. Mitsubishi Electric Cooling and Heating.

8. Rheem Manufacturing Company; Heating and Cooling Products.

9. Samsung HVAC.

10. Trane.

11. YORK; brand of Johnson Controls International plc, Building Solutions North America.

B. Indoor Units (5 tons (18 kW) or Less:

1. Concealed Evaporator-Fan Components:

a. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

b. Insulation: Faced, glass-fiber duct liner.

c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.

d. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm); leak tested to 300 psig (2070 kPa) underwater; with a two-position control valve.

e. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.

f. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.

g. Fan Motors:

1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230500 "Common Work Results for HVAC."

2) Multitapped, multispeed with internal thermal protection and permanent lubrication.

3) Wiring Terminations: Connect motor to chassis wiring with plug connection.

h. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

i. Filters: Permanent, cleanable.

j. Condensate Drain Pans:

1) Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

a) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.

b) Depth: A minimum of 2 inches (50 mm) deep.

2) Single-wall, galvanized-steel sheet.

3) Double-wall, galvanized-steel sheet with space between walls filled with foam insulation and moisture-tight seal.

4) Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.

a) Minimum Connection Size: NPS 1 (DN 25).

5) Pan-Top Surface Coating: Asphaltic waterproofing compound.

6) Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

C. Outdoor Units (5 tons (18 kW) or Less)

1. Air-Cooled, Compressor-Condenser Components:

a. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

b. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1) Compressor Type: Scroll.

2) Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.

3) Refrigerant: R-410A.

4) Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

c. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.

d. Fan: Aluminum-propeller type, directly connected to motor.

e. Motor: Permanently lubricated, with integral thermal-overload protection.

f. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
g. Mounting Base: Polyethylene.

D. Accessories:

1. Control equipment and sequence of operation are specified.

2. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

3. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

a. Compressor time delay.

b. 24-hour time control of system stop and start.

c. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.

d. Fan-speed selection including auto setting.

4. Automatic-reset timer to prevent rapid cycling of compressor.

5. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

6. Drain Hose: For condensate.

7. Monitoring:

a. Monitor constant and variable motor loads.

b. Monitor variable-frequency-drive operation.

c. Monitor economizer cycle.

d. Monitor cooling load.

e. Monitor air distribution static pressure and ventilation air volumes.

E. Capacities and Characteristics:

1. Cooling Capacity:

a. Total: 24,000 Btu/h (kW).

b. Sensible: 20,4000 Btu/h (kW).

c. EER: 12.0.

2. Heating Capacity:

a. Type: Electric.

b. Total Capacity: 28 Btu/h (kW).

c. Heating Season Performance Factor: 8.0.

d. Electric Heating Coil:

1) Volts: 208 V ac.

2) Phase: Single.

3) Frequency: 60 Hz.

4) Steps: Two.

e. Gas Heating Section:

3. Auxiliary Heating Capacity:

a. Type: Electric.

b. Total Capacity: 24.0 mbh

c. Volts: 208 V ac.

d. Phase: Single.

e. Frequency: 60 Hz.

4. Indoor Unit:

a. Fan Motor Electrical Characteristics:

1) Volts: 208 V ac.

2) Phase: Single.

3) Frequency: 60 Hz.

b. Airflow: 700 cfm (L/s).

5. Outdoor Unit:

a. Type: Air cooled.

b. Electrical Characteristics:

1) Volts: 208.

2) Phase: Single.

3) Frequency: 60 Hz.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified. Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

3. Comply with requirements for vibration isolation and seismic control devices.

4. Comply with requirements for vibration isolation devices.

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Water Coil Connections: Comply with requirements specified. Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 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. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238233 - CONVECTORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hydronic convectors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include details and dimensions of custom-fabricated enclosures.

4. Indicate location and size of each field connection.

5. Indicate location and arrangement of piping valves and specialties.

6. Indicate location and arrangement of integral controls.

7. Include enclosure joints, corner pieces, access doors, and other accessories.

8. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HOT-WATER CONVECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Engineered Air.

2. Slant/Fin Corp.

3. Sterling HVAC Products; a Mestek Company.

4. Trane.

B. Heating Elements: Seamless copper tubing mechanically expanded into evenly spaced aluminum fins and rolled into cast-iron or brass headers with inlet/outlet and air vent; steel side plates and supports. Factory-pressure-test element at minimum 100 psig (690 kPa).

1. Element Height: 12 inches (mm).

2. Element Depth: 5-1/2 inches (mm).

3. Element Length: Multiple lengths

4. Heat Output: 600 Btu/h per ft. (W/m).

5. Average Water Temperature: 180 deg F (82 deg C).

6. Temperature Drop: 20 deg F (11.1 deg C).

C. Front and Top Panel: Minimum 0.0528-inch- (1.35-mm-) thick steel with exposed corners rounded; removable front panels with tamper-resistant fasteners braced and reinforced for stiffness.

D. Wall-Mounted Back and End Panels: Minimum 0.0428-inch- (1.1-mm-) thick steel.

E. Floor-Mounted Pedestals: Conceal conduit for power and control wiring at maximum 36-inch (914-mm) spacing. Pedestal-mounted back panel shall be solid panel matching front panel.

F. Support Brackets: Locate at maximum 36-inch (914-mm) spacing to support front panel and element.

G. Insulation: 1/2-inch- (13-mm-) thick, fibrous glass on inside of the back of the enclosure.

H. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.

I. Damper: Knob-operated internal damper.

J. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches (150 by 175 mm), integral with enclosure.

K. Enclosure Style: Sloped top.

1. Front Inlet Grille: Punched louver; painted to match enclosure.

2. Front Inlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.

a. Mill-finish aluminum.

b. Anodized finish, color as selected by Architect from manufacturer's standard colors.

c. Painted to match enclosure.

3. Front Outlet Grille: Punched louver; painted to match enclosure.

4. Front Outlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.

a. Mill-finish aluminum.

b. Anodized finish, color as selected by Architect from manufacturer's standard colors.

c. Painted to match enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install convectors level and plumb.

B. Install valves within reach of access door provided in enclosure.

C. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.

D. Install piping within pedestals for freestanding units.

3.2 CONNECTIONS

A. Piping installation requirements are specified. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect hot-water convectors and components to piping.

1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.

2. Install shutoff valve on inlet; install strainer, steam trap, and shutoff valve on outlet.

C. Install control valves as required.

D. Install piping adjacent to convectors to allow service and maintenance.

E. Ground electric convectors.

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start convectors to confirm proper operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Convectors will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 238233

SECTION 238316 - RADIANT-HEATING HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PEX pipe and fittings.
2. PEX/AL/PEX pipe and fittings.
3. Distribution manifolds.
4. Piping specialties.
5. Controls.

1.2 ACTION SUBMITTALS

A. Product Data:

1. PEX pipe and fittings.
2. PEX/AL/PEX pipe and fittings.
3. Distribution manifolds.
4. Piping specialties.
5. Controls.
6. For each product, provide the following:

a. Data for piping, fittings, manifolds, specialties, and controls; include pressure and temperature ratings, oxygen-barrier performance, fire-performance characteristics, and water-flow and pressure-drop characteristics.

B. Shop Drawings: Show piping size, layout, and details drawn to scale, including valves, manifolds, controls, and support assemblies, and their attachments to building structure.

1. Shop Drawing Scale: 1/4 inch = 1 foot (1:50).

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For radiant-heating piping valves and equipment to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PEX PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alleguard (formerly Amvic Building System).
2. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).
3. FloorHeat LLC.
4. Heat Innovations Inc.
5. HeatLink Group Inc.
6. IPEX USA LLC.
7. Infloor Radiant Heating Inc.
8. MrPex Systems Inc.
9. Oatey Co.
10. REHAU.
11. SharkBite, A Division of Reliance Worldwide Corporation.

B. Pipe Material: PEX plastic in accordance with ASTM F876.

C. Oxygen Barrier: Limit oxygen diffusion through the tube to maximum 0.10 mg per cu. m/day at 104 deg F (40 deg C) in accordance with DIN 4726.

D. Fittings: ASTM F1807, metal insert and copper crimp rings ASTM F1960, cold expansion fittings and reinforcing rings.

E. Pressure/Temperature Rating: Minimum 90 psig (620 kPa) and 180 deg F (82 deg C).

2.2 PEX/AL/PEX PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

2. FloorHeat LLC.

3. Heat Innovations Inc.

4. HeatLink Group Inc.

5. IPEX USA LLC.

6. Infloor Radiant Heating Inc.

7. MrPex Systems Inc.

8. REHAU.

9. SharkBite, A Division of Reliance Worldwide Corporation.

10. Sioux Chief Manufacturing Company, Inc.

11. Uponor Inc.

B. Pipe Material: PEX plastic bonded to the inside and outside of a welded aluminum tube in accordance with ASTM F1281.

C. Oxygen Barrier: Limit oxygen diffusion through the pipe to maximum 0.10 mg per cu. m/day at 104 deg F (40 deg C) in accordance with DIN 4726.

D. Fittings: ASTM F1974, metal insert fittings with split ring and compression nut (compression joint) or metal insert fittings with copper crimp rings (crimp joint).

E. Flame-Spread and Smoke-Developed Indices: 25 and 50 or less, respectively, tested in accordance with ASTM E84.

F. Pressure/Temperature Rating: Minimum 125 psig (860 kPa) and 180 deg F (82 deg C).

2.3 PIPING SPECIALTIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

2. FloorHeat LLC.

3. Heat Innovations Inc.

4. Infloor Radiant Heating Inc.

5. MrPex Systems Inc.

6. REHAU.

7. SharkBite, A Division of Reliance Worldwide Corporation.

8. Therma-HEXX.

9. Uponor Inc.

10. Viega LLC.

B. Cable Ties:

1. Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

2. Minimum Width: 1/8 inch (3 mm).

3. Tensile Strength: 20 lb (9 kg), minimum.

4. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

C. Floor-Mounting Staples:

1. Steel, with corrosion-resistant coating and smooth finish without sharp edges.

2. Minimum Thickness: 3/32 inch (2.4 mm).

3. Width: Minimum, wider than tubing.

D. Floor-Mounting Clamps:

1. Two bolts, steel, with corrosion-resistant coating and smooth finish without sharp edges.

2. Minimum Thickness: 3/32 inch (2.4 mm).

3. Width: Minimum, wider than tubing.

E. Floor-Mounting Tracks:

1. Aluminum or plastic channel track with smooth finish and no sharp edges.

2. Minimum Thickness: 1/16 inch (1.6 mm).

3. Slot Width: Snap fit to hold tubing.

4. Slot Spacing: 2-inch (50-mm) intervals.

F. Channeled Subfloor:

1. Plywood, APA-rated subfloor panel, composed of premium, tongue-and-groove, seven-layer, Douglas fir structural subfloor panels.

2. Particleboard manufactured to comply with the EPA's Formaldehyde Emission Standards for Composite Wood Products Act.

3. Clad panel with minimum 0.025-inch- (0.635-mm-) thick aluminum recessed in the grooves sized to maintain contact with radiant piping.

G. Modular Interlocking Blocks:

1. Polypropylene snap-together blocks with grooves to support piping.

a) Galvanized sheet metal or aluminum emission plates.

b) Natural mineral board cover panel.

H. Heat-Emission Plates:

1. Formed aluminum suitable for radiant-heating piping.

2. Minimum Thickness: 1/16 inch (1.6 mm).

3. Slot Width: Snap fit to maintain pressure fit on tubing.

I. Temperature-control devices and sequence of operations as specified.

J. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

2. Danfoss, Inc.

3. Heat Innovations Inc.

4. HeatLink Group Inc.

5. Honeywell Building Solutions; Honeywell International, Inc.

6. Infloor Radiant Heating Inc.

7. MrPex Systems Inc.

8. REHAU.

9. Slant/Fin Corp.

10. tekmar; A WATTS Brand.

K. Wall-Mounted Thermostat:

1. Minimum temperature range from 50 to 90 deg F (10 to 32 deg C).

2. Manually operated with on-off switch.

3. Day and night setback and clock program with minimum four periods per day.

4. Operate pumps or open zone control valves if room temperature falls below the thermostat setting, and stop pumps or close zone control valves when room temperature rises above the thermostat setting.

L. Heated-Panel Thermostat:

1. Remote bulb unit with adjustable temperature range from 50 to 90 deg F (10 to 32 deg C).

2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected pump or zone control valve.

3. Remote bulb on capillary tube, resistance temperature device, or thermistor for directly sensing radiant-panel temperature.

4. Stop pump or close zone control valves if heated-panel thermostat setting is exceeded.

5. Corrosion-resistant, waterproof control enclosure.

M. Precipitation and Temperature Sensor:

N. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Apollo Valves; a brand of Aalberts Integrated Piping Systems (Aalberts Industries).

2. Uponor Inc.

3. Viega LLC.

4. Zurn; Zurn Elkay.

5. tekmar; A WATTS Brand.

a. Automatic control with manual on, automatic, and standby/reset switch.

b. Surface Temperature Span: 40 to 60 deg F (4 to 16 deg C).

c. Adjustable Delay Off Span: 30 to 90 minutes.

1) Precipitation and temperature sensors are to sense the surface conditions of pavement and is to be programmed to operate pump and zone control valves as follows:

d. Start Pump or Open Zone Control Valves: Following two-minute delay if ambient temperature is below 40 deg F (4 deg C) and precipitation is detected.

e. Modulate zone control valve to maintain slab surface at 45 deg F (7 deg C).

f. Stop Pump or Close Zone Control Valves: On detection of a dry surface plus time delay.

g. Sensor-controller overrides zone control valve to prevent hot-water inlet temperature from exceeding 140 deg F (60 deg C) and slab surface temperature from exceeding 68 deg F (20 deg C).

1) Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.

2) Minimum 30 A contactor to start pump and open valves.

3) Precipitation sensor is to be flush-mounted in pavement.

4) Provide relay with contacts to indicate operational status, on or off, for interface with central HVAC control-system workstation.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Install the following types of radiant-heating piping for the applications described:

1. Piping in Ceilings and Walls: PEX PEX/AL/PEX.

2. Piping in Subfloors: PEX PEX/AL/PEX.

3.2 INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings or coordination drawings.

B. Install radiant-heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.

C. Connect radiant piping to manifold in a reverse-return arrangement.

D. Do not bend pipes in radii smaller than manufacturer's minimum bend radius dimensions.

E. Install manifolds in accessible locations or install access panels to provide maintenance access as required in Section 081113 "Hollow Metal Doors and Frames."

F. Fire- and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations.

G. Piping in Exterior Pavement:

1. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.

2. Space cable ties a maximum of 18 inches (457 mm) o.c. and at center of turns or bends.

3. Maintain 3-inch (75-mm) minimum cover.

4. Install a sleeve of 3/8-inch- (9.5-mm-) thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches (250 mm) on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.

5. Maintain minimum 40 psig (275 kPa) pressure in piping during concrete placement and continue for 24 hours after placement.

H. Piping in Interior Reinforced-Concrete Floors:

1. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.

2. Space cable ties a maximum of 18 inches (457 mm) o.c. and at center of turns or bends.

3. Maintain 2-inch (50-mm) minimum cover.

4. Install a sleeve of 3/8-inch- (9.5-mm-) thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches (250 mm) on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.

5. Maintain minimum 40 psig (275 kPa) pressure in piping during concrete placement and continue for 24 hours after placement.

I. Piping in Level Fill Concrete Floors (Not Reinforced):

1. Secure piping in concrete floors by attaching pipes to subfloor using tracks, clamps, or staples.

2. Space tracks, clamps, or staples a maximum of 18 inches (457 mm) o.c. and at center of turns or bends.

3. Maintain 3/4-inch (19-mm) minimum cover.

4. Install a sleeve of 3/8-inch- (9.5-mm-) thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches (250 mm) on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.

5. Maintain minimum 40 psig (275 kPa) pressure in piping during the concrete pour and continue for 24 hours during curing.

J. Piping in Ceiling and Walls:

1. Secure piping by attaching pipes to ceiling or wall substrate using clamps or staples.

2. Space clamps or staples a maximum of 18 inches (457 mm) o.c. and at center of turns or bends.

3. Maintain 1-1/2-inch (38-mm) minimum plaster cover.

4. Maintain minimum 40 psig (275 kPa) pressure in piping during the plaster application and continue for 24 hours during curing.

K. Piping in Subfloor:

1. Secure piping by laying in subfloor channels or modular interlocking blocks.

2. Use straight-channel panels or blocks in the center and curved-channel panels or blocks at the ends.

3. Finish floor with mineralboard panel cover or finished floor surface.

L. Piping below Wood Floor:

1. Secure piping by attaching pipes to subfloor using heat-emission plates, clamps, or staples.

2. Space heat-emission plates, clamps, or staples a maximum of 4 inches (100 mm) o.c. and at center of turns or bends.

3. Install heat-emission plates on underside of wood subfloor with maximum space between plates, as noted above, to maintain pipe contact with floor.

M. Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved by Architect.

N. After system balancing has been completed, mark balancing valves to permanently indicate final position.

O. Perform the following adjustments before operating the system:

1. Open valves to fully open position.

2. Check operation of automatic valves.

3. Set temperature controls so all zones call for full flow.

4. Purge air from piping.

P. After concrete or plaster heating panel has cured as recommended by concrete or plaster supplier, operate radiant-heating system as follows:

1. Start system heating at a maximum of 10 deg F (6 deg C) above the ambient radiant-panel temperature and increase 10 deg F (6 deg C) each following day until design temperature is achieved.

2. For freeze protection, operate at a minimum of 60 deg F (16 deg C) supply-water temperature.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Prepare radiant-heating piping for testing as follows:

a. Open all isolation valves and close bypass valves.

b. Open and verify operation of zone control valves.

c. Flush with clean water and clean strainers.

2. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

a. Leak Test: After installation, charge system and test for leaks. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than 100 psig (690 kPa). Repair leaks and retest until no leaks exist.

b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Radiant-heating piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Protect hydronic piping system from damage during construction.

END OF SECTION 238316

BARRY ISETT & associates INC

MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 26

Electrical

SECTION 260000 - ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 RELATED WORK

A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for minor electrical demolition for remodeling.

1. Section 260511 – Requirements For Electrical Systems.

B. In the event of conflict regarding minor electrical demolition requirements between this Section and any other Section, the provisions of this Section shall govern.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: as specified in individual Sections.

B. Provide all materials necessary for work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. All demolitions or modifications to existing systems shall be coordinated through Owner's Representative. Demolition drawings are based on casual field observation and existing record documents. Therefore, the accuracy or exactness of the drawings is not guaranteed. The Contractor shall verify that field measurements and circuiting arrangements are as shown on Drawings and abandoned wiring and equipment serve only abandoned facilities. The Contractor shall be responsible for reporting discrepancies to Engineer before disturbing existing installation.

B. Beginning of demolition means Contractor accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal. Provide temporary wiring and connections to maintain remaining systems in service during demolition and/or modification. Owner reserve the right up to 24 hours prior to any scheduled event to delay or suspend shutdowns or outages to more convenient times at no additional cost.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new plan drawings.

B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes full length from source to device. Cut embedded or concealed conduit flush with walls and floors, and patch surfaces.

C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

D. Disconnect and remove abandoned panelboards and distribution equipment.

E. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

F. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

G. Repair adjacent construction and finishes damaged during demolition and extension work.

H. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

I. Extend existing installations using materials and methods compatible with existing electrical installation or as specified.

J. The level of completion shall be demonstrated to Owner’s Representative.

K. Where equipment is indicated to be demolished and returned to Owner, the Contractor shall include the delivery of this equipment to the Owner's site storage area. Remove with care all equipment to be relocated. Repair or replace of newly damaged equipment is the responsibility of the Contractor.

3.4 CLEANING AND REPAIR

A. The Contractor shall follow Owner’s clean work policy and shall include the removal of trash and demolished material from the building or work area at the end of the each day and removal from the site once a week.

B. The Contractor shall be responsible for repairing adjacent construction and finishes damaged during demolition and/or modification. The Contractor shall be responsible for the removal of ceiling tiles required in the demolition work. The Contractor shall be responsible for the replacement of damaged tiles and reinstallation of the ceiling prior to final acceptance.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

3.5 DISPOSITION OF MATERIAL AND EQUIPMENT

A. Review with the Owner materials that have been removed and are no longer required, to determine any which the Owner may desire to keep. Deliver those materials that the Owner desires to the Owner's specified location.

B. For those materials not required by the Owner, dispose of them in accordance with applicable regulations.

C. Equipment to Be Removed and Reinstalled or Relocated: Some equipment is being removed to be reinstalled later at a different location. This equipment shall be removed and prepared for storage with weather-resistant and physical protection suitable for moving to a storage location off the construction site, but on the campus as designated by the Owner.

END OF SECTION 260000

SECTION 260511 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section applies to all sections of Division 26.

B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, switchgear, panelboards, and other items and arrangements for the specified items are shown on the drawings.

C. Electrical service entrance equipment and arrangements for temporary and permanent connections to the campus utility system shall conform to the campus utility requirements. Coordinate fuses, circuit breakers and relays with the campus electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.

D. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC.

1.2 MINIMUM REQUIREMENTS

A. The International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.

B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.3 TEST STANDARDS

A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.

2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3. Certified: Materials and equipment which:

   a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.

   b. Are periodically inspected by a NRTL.

   c. Bear a label, tag, or other record of certification.

4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturer’s Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.

B. Product Qualification:

1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.

2. The Architect reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

A. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.

B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.6 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available.

B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.

2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

3. Components shall be compatible with each other and with the total assembly for the intended service.

4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

E. When Factory Testing Is Specified:

1. Four copies of certified test reports shall be furnished to the owner two weeks prior to final inspection and not more than 90 days after completion of the tests.

2. When materials and equipment fail factory tests, and re-testing and re-inspection is required, the Contractor shall be liable for all additional expenses for the re-testing.

1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

A. Where the Architect or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.8 MATERIALS AND EQUIPMENT PROTECTION

A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.

1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.

2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.

3. Damaged equipment shall be repaired or replaced, as determined by the Owner and Architect.

4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.

5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA, in addition to other references required by contract.

B. Job site safety and worker safety is the responsibility of the Contractor.

C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:

1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.

D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility. Refer to Article OPERATIONS AND STORAGE AREAS under Division 01 Section “GENERAL REQUIREMENTS.”

E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Division 01 Section “GENERAL REQUIREMENTS.”

F. Coordinate location of equipment and conduit with other trades to minimize interference.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working clearances shall not be less than specified in the NEC.

C. Inaccessible Equipment:

1. Where the Architect determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Owner.

2. "Readily accessible” is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company’s system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company’s system and obtain electric utility company approval for sizes and settings of these devices.

1.11 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, generators, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.

B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 1/2 inch high. Identification signs shall indicate equipment designation, rated bus amperage, source name and location, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall indicate the arc hazard boundary (inches), working distance (inches), arc flash incident energy at the working distance (calories/cm2), required PPE category and description including the glove rating, voltage rating of the equipment, limited approach distance (inches), restricted approach distance (inches), prohibited approach distance (inches), equipment/bus name, date prepared, and manufacturer name and address.

1.12 SUBMITTALS

A. Submit to the Architect in accordance with Division 01 Section “SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. “

B. The Architect's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.

C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Architect to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.

D. The submittals shall include the following:

1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.

2. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.

3. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.

E. Maintenance and Operation Manuals:

1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.

2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.

3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.

4. The manuals shall include:

a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.

b. A control sequence describing start-up, operation, and shutdown.

c. Description of the function of each principal item of equipment.

d. Installation instructions.

e. Safety precautions for operation and maintenance.

f. Diagrams and illustrations.

g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.

h. Performance data.

i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.

j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

F. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.

1.13 SINGULAR NUMBER

A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.15 ACCEPTANCE CHECKS AND TESTS

A. The Contractor shall furnish the instruments, materials, and labor for tests.

B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer's representatives and technicians so that a complete, functional, and operational system is delivered to the Owner.

C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment and repeat the tests. Repair, replacement, and retesting shall be accomplished at no additional cost to the Owner.

D. Provide inspection and testing as outlined in ANSI/NETA ATS-2009 Section 7.3.2.

1.16 WARRANTY

A. All work performed, and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Owner.

1.17 INSTRUCTION

A. Instruction to designated Architect personnel shall be provided for the particular equipment or system as required in each associated technical specification section.

B. Furnish the services of competent instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation and shall be trained in operating theory as well as practical operation and maintenance procedures.

C. A training schedule shall be developed and submitted by the Contractor and approved by the Owner at least 30 days prior to the planned training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 260511

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.

2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. Alpha Wire.
3. Belden Inc.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. Southwire Incorporated.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2, Type XHHW-2, and Type SO.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC and Type SO with ground wire.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway, Metal-clad cable, Type MC.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations o.f fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.

    b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

    c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.

2. Results that comply with requirements.

3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.

2. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Ground rods.

2. Test wells.

3. Ground rings.

4. Grounding arrangements and connections for separately derived systems.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

    a. Instructions for periodic testing and inspection of grounding features at ground rings, test wells, and grounding connections for separately derived systems, based on NETA MTS.

        1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.

        2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.

2. Dossert; AFL Telecommunications LLC.

3. ERICO International Corporation.

4. Fushi Copperweld Inc.

5. Galvan Industries, Inc.; Electrical Products Division, LLC.

6. Harger Lightning and Grounding.

7. ILSCO.

8. O-Z/Gedney; A Brand of the EGS Electrical Group.

9. Robbins Lightning, Inc.

10. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.

3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.

4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.

2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator docking station location. The electrode shall be connected to the frame of the docking station.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If

necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a

separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

G. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than No. 8 AWG.

2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.

3.6 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column and to the Ufer Ground, extending around the perimeter of building area or item indicated.

1. Install copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.

2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.

2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.

3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

4. Substations and Pad-Mounted Equipment: 5 ohms.

5. Manhole Grounds: 10 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.

3. Nonmetallic slotted channel systems. Include Product Data for components.

4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. ERICO International Corporation.

d. GS Metals Corp.

e. Thomas & Betts Corporation.

f. Unistrut; Tyco International, Ltd.

g. Wesanco, Inc.

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

6. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. Fabco Plastics Wholesale Limited.

d. Seasafe, Inc.

3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

4. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.

5. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Hilti Inc.

        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

        3) MKT Fastening, LLC.

        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Cooper B-Line, Inc.; a division of Cooper Industries.

        2) Empire Tool and Manufacturing Co., Inc.

        3) Hilti Inc.

4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least [25] percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

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

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.

2. Allied Tube & Conduit.

3. Anamet Electrical, Inc.

4. Electri-Flex Company.

5. O-Z/Gedney.

6. Picoma Industries.

7. Republic Conduit.

8. Robroy Industries.

9. Southwire Company.

10. Thomas & Betts Corporation.

11. Western Tube and Conduit Corporation.

12. Wheatland Tube Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.

2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

2. Fittings for EMT:

a. Material: Steel.

b. Type: Compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.

2. Anamet Electrical, Inc.

3. Arnco Corporation.

4. CANTEX Inc.

5. CertainTeed Corporation.

6. Condux International, Inc.

7. Electri-Flex Company.

8. Kraloy.

9. Lamson & Sessions; Carlon Electrical Products.

10. Niedax-Kleinhuis USA, Inc.

11. RACO; Hubbell.

12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

I. RTRC: Comply with UL 1684A and NEMA TC 14.

J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

K. Fittings for LFNC: Comply with UL 514B.

L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

M. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.

2. Hoffman.

3. Mono-Systems, Inc.

4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Type 1, Screw-cover type. Type 3R, Flanged-and-gasketed type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.

2. Cooper Technologies Company; Cooper Crouse-Hinds.

3. EGS/Appleton Electric.

4. Erickson Electrical Equipment Company.

5. FSR Inc.

6. Hoffman.

7. Hubbell Incorporated.

8. Kraloy.

9. Milbank Manufacturing Co.

10. Mono-Systems, Inc.

11. O-Z/Gedney.

12. RACO; Hubbell.

13. Robroy Industries.

14. Spring City Electrical Manufacturing Company.

15. Stahlin Non-Metallic Enclosures.

16. Thomas & Betts Corporation.

17. Wiremold/Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.

2. Type: Fully adjustable.

3. Shape: Rectangular.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum or galvanized, cast iron with gasketed cover.

L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

M. Gangable boxes are prohibited.

N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Plastic.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. Cabinets:

1. NEMA 250, Type 1 or Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armorcast Products Company.

b. Carson Industries LLC.

c. NewBasis.

d. Oldcastle Precast, Inc.

e. Quazite: Hubbell Power System, Inc.

f. Synertech Moulded Products.

2. Standard: Comply with SCTE 77.

3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

6. Cover Legend: Molded lettering, As indicted on drawings.

7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armorcast Products Company.

b. Carson Industries LLC.

c. NewBasis.

d. Nordic Fiberglass, Inc.

e. Oldcastle Precast, Inc; Christy Concrete Products.

f. Quazite: Hubbell Power System, Inc; Hubbell Power Systems.

g. Synertech Moulded Products.

2. Standard: Comply with SCTE 77.

3. Color of Frame and Cover: Gray where installed in hard surfaces and green where installed in grass or landscaped areas.

4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

7. Cover Legend: Molded lettering, As indicated on drawings.

8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

9. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.

2. Concealed Conduit, Aboveground: GRC.

3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased where indicated on Drawings.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed, Not Subject to Severe Physical Damage: EMT.

3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

   a. Loading dock/area.

   b. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT, and/or metal clad cable, Type MC.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

6. Damp or Wet Locations: GRC.

7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm)of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m)intervals.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Arrange raceways to keep a minimum of 2 inches (50 mm)] of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.

3. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

V. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C)] temperature change.

b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC in damp or wet locations not subject to severe physical damage.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Section 312000 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

   b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.

7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.

2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:

a. Advance Products & Systems, Inc.

b. CALPICO, Inc.

c. Metraflex Company (The).

d. Pipeline Seal and Insulator, Inc.

e. Proco Products, Inc.

2. Sealing Elements: EPDM or Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates Stainless steel.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Presealed Systems.
b. Or equal as approved by the professional.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical

sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.

2. Legend: Indicate voltage and system or service type.

C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

G. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.

2. Legend: Indicate voltage and system or service type.

C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil-thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

F. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

G. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

H. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil-thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

G. Write-On Tags: Polyester tag, 0.015 inchthick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

2.5 FLOOR MARKING TAPE

A. 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.

2. Printing on tape shall be permanent and shall not be damaged by burial operations.

3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.

2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.

3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

4. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

5. Overall Thickness: 5 mils.

6. Foil Core Thickness: 0.35 mil.

7. Weight: 28 lb/1000 sq. ft.

8. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.7 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.

2. 1/4-inch grommets in corners for mounting.

3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.

2. 1/4-inch grommets in corners for mounting.

3. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.8 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.

2. Punched or drilled for mechanical fasteners.

3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.10 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.

2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.

3. UL 94 Flame Rating: 94V-0.

4. Temperature Range: Minus 50 to plus 284 deg F.

5. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-footmaximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.

2. Power.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

b. Colors for 208/120-V Circuits:

1) Phase A: Black.

2) Phase B: Red.

3) Phase C: Blue.

c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use write-on tags.

E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags or self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes or self-adhesive vinyl labels with the conductor designation.

H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.

2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.

2. Identify system voltage with black letters on an orange background.

3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.

b. Controls with external control power connections.

M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer at temporary generator Rotary Docking Station connection.

O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.

c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.

b. Enclosures and electrical cabinets.

c. Access doors and panels for concealed electrical items.

d. Outdoor Switchgear.

e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

f. Emergency system boxes and enclosures.

g. Enclosed switches.

h. Enclosed circuit breakers.

i. Enclosed controllers.

j. Power transfer equipment.

k. Contactors.

l. Remote-controlled switches, dimmer modules, and control devices.

m. Monitoring and control equipment.

END OF SECTION 260553

SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

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 a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals may be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.

2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary

submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, utilize software by one of the following:

1. ESA Inc.

2. Operation Technology, Inc.

3. Power Analytics, Corporation.

4. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.

2. Cable size and lengths.

3. Transformer kilovolt ampere (kVA) and voltage ratings.

4. Distribution switchboard and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. No AC Decrement (NACD) ratio.

e. Equivalent impedance.

f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.

2. Protective device clearing time.

3. Duration of arc.

4. Arc-flash boundary.

5. Working distance.

6. Incident energy.

7. Hazard risk category.

8. Recommendations for arc-flash energy reduction.

G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.

2. Nominal voltage.

3. Flash protection boundary.

4. Hazard risk category.

5. Incident energy.

6. Working distance.

7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

2. Exclude equipment rated 240-V ac 1-PHASE or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Existing 5kV Switchgear.

2. Transformer primary and secondary terminals.

3. Low-voltage distribution panelboard.

4. Automatic transfer switches.

5. Branch circuit panelboards.

3.3 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.

2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.

2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.

2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.4 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.

2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Gather and tabulate the following input data to support coordination study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Obtain electrical power utility impedance at the service.

3. Power sources and ties.

4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.

5. For reactors, provide manufacturer and model designation, voltage rating and impedance.

6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.

7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.

8. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.

9. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.

10. Motor horsepower and NEMA MG 1 code letter designation.

11. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

12. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.5 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

1. Low-voltage distribution panelboard.

2. Automatic transfer switches.

3. Branch circuit panelboards.

3.6 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.7 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

SECTION 260923 - LIGHTING CONTROL DEVICES

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. Time switches.
2. Indoor occupancy sensors.
3. Outdoor motion sensors.
4. Lighting contactors.
5. Emergency shunt relays.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For solvents and adhesives, indicating VOC content.
3. Laboratory Test Reports: For solvents and adhesives, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 DIGITAL IN WALL TIMER

A. Basis-of-Design Product: Subject to compliance with requirements, provide Intermatic ST01 or comparable product by one of the following:

1. Cooper Industries, Inc.

2. Invensys Controls.

3. Leviton Manufacturing Co., Inc.

4. NSi Industries LLC; TORK Products.

5. Tyco Electronics; ALR Brand.

B. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application and complying with UL917.

C. Solid state electronic control with digital LCD.

D. Program for 24-hour or 7-day load control.

E. Automatic daylight savings time adjustment

F. Compatible with lighting load shown on the drawings.

G. Continuously shows load status, mode, and time.

H. Battery backup.

I. Ratings:

1. Resistive: 15Amp, 120-277V.

2.2 INDOOR OCCUPANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Ceiling Mounted 360 Distribution: Watt Stopper #DT-355

2. Ceiling Mounted Hallway Distribution: Watt Stopper #WT-2255

3. Corner Mounted: Watt Stopper #DT-200

4. Or comparable product by one of the following:

    a. Bryant Electric.

    b. Cooper Industries, Inc.

    c. Hubbell Building Automation, Inc.

    d. Lutron Electronics Co., Inc.

    e. RAB Lighting.

    f. Sensor Switch, Inc.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.

4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

5. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.

    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.

    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

7. Bypass Switch: Override the "on" function in case of sensor failure.

8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bryant Electric.

2. Cooper Industries, Inc.

3. Hubbell Building Automation, Inc.

4. Lutron Electronics Co., Inc.

5. RAB Lighting.

6. Sensor Switch, Inc.

7. Watt Stopper.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.

3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft.

2. Sensing Technology: Dual technology - PIR and ultrasonic.

3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."

4. Voltage: Match the circuit voltage; dual-technology type.

5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.

6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

D. Wall-Switch Sensor:

1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft.

2. Sensing Technology: Dual technology - PIR and ultrasonic.

3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."

4. Voltage: Match the circuit voltage; dual-technology type.

5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.

6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.4 HIGH-BAY OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bryant Electric.

2. Cooper Industries, Inc.

3. Hubbell Building Automation, Inc.

4. Lutron Electronics Co., Inc.

5. RAB Lighting.

6. Sensor Switch, Inc.

7. Watt Stopper.

B. General Description: Solid-state unit. The unit is designed to operate with the lamp and ballasts indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Operation: Turn lights on when coverage area is occupied, and to half-power when unoccupied; with a time delay for turning lights to half-power that is adjustable over a minimum range of 1 to 16 minutes.

3. Continuous Lamp Monitoring: When lamps are dimmed continuously for 24 hours, automatically turn lamps on to full power for 15 minutes for every 24 hours of continuous dimming.

4. Operating Ambient Conditions: 32 to 149 deg F.

5. Mounting: Threaded pipe.

6. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

7. Detector Technology: PIR.

C. Detector Coverage: User selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet.

D. Accessories: Obtain manufacturer's installation and maintenance kit with laser alignment tool for sensor positioning and power port connectors.

2.5 EMERGENCY SHUNT RELAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lighting Control and Design.

2. Watt Stopper.

3. Bodine.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 277 V.

2.6 COMBINATION WALL BOX DIMMER/SWITCH/OCCUPANCY SENSORS

A. Combination wall box 0-10v dimmer/switch/occ sensors shall be PIR type with 180 deg field of view and minimum 1000 sq ft of major motion coverage. It shall be compatible with 0-10vcd led/flr lamps and capable of functioning in a 3-way switching arrangement.

1. Basis of design is eaton osw-p-010, or approved equal.

2. Device color selection shall be from manufacturer's full range. Final selection shall be by architect.

2.7 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

C. Sensors shall be set to be manual on or controlled to automatically turn on the lighting to not more than 50% power. Full automatic-on controls shall be permitted to control lighting in public corridors, stairways, restrooms, and building entrance and lobby.

D. Sensors shall be set to automatically turn off lights within 30 minutes of all occupants leaving the space.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

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. Distribution panelboards.

2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.

2. Detail enclosure types and details for types other than NEMA 250, Type 1.

3. Detail bus configuration, current, and voltage ratings.

4. Short-circuit current rating of panelboards and overcurrent protective devices.

5. Include evidence of NRTL listing for series rating of installed devices.

6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

7. Include wiring diagrams for power, signal, and control wiring.

8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field Quality-Control Reports:

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.

2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.

3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

5. Circuit Breakers Including Shunt trip operation types: Two spares for each panelboard where shunt trip installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

1.10 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).

   b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect and Owner no fewer than (7) seven days in advance of proposed interruption of electric service.

2. Do not proceed with interruption of electric service without Owner's written permission.

3. Comply with NFPA 70E.

1.11 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.

B. Enclosures: Surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.

6. Finishes:

a. Panels and Trim: Steel or Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

b. Back Boxes: Galvanized steel, Same finish as panels and trim.

c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

7. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top and bottom as required on Drawings.

D. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

5. Split Bus: Vertical buses divided into individual vertical sections.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Main and Neutral Lugs: Mechanical type.

3. Ground Lugs and Bus-Configured Terminators: Mechanical type.

4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm)] high, provide two latches, keyed alike.

D. Mains: Circuit breaker.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only as indicated on Drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.

    b. Long- and short-time pickup levels.

    c. Long- and short-time time adjustments.

    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.

    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

    e. Shunt Trip: 120 - V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

    f. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.

    g. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

    h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

    i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.

B. Retain first paragraph below for floor-mounted distribution panelboards. Even if floor mounted, all panelboard cabinets must still be securely attached to a vertical wall or surface.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements.

E. Ensure that, whatever height is selected for top of trim in first paragraph below, the operating handle of top-most switch or circuit breaker, in on position, is not higher than 79 inches (2000 mm)above finished floor or grade.

F. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

H. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

I. Install filler plates in unused spaces.

J. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

K. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

L. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.

c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified.

C. Circuit changes made during load balancing may negate color-coding of phases and circuits. If load balancing proves undesirable or is to be performed by others, delete paragraph below.

D. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262702 - EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. The work under this section includes electrical connections to equipment specified under other Divisions and/or Sections, or furnished by Owner, including, but not limited to:

1. HVAC and Plumbing motors, VFDs, and panels

2. Elevators

1.2 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

B. Division 26 Section “Low-Voltage Electrical Power Conductors and Cables.”

C. Division 26 Section “Raceway and Boxes for Electrical Systems.”

1.4 SUBMITTALS

A. Product Data: Provide data for cord and wiring devices.

1.5 COORDINATION

A. Coordinate all equipment requirements with the various contractors and the Owner. Review the complete set of drawings and specifications to determine the extent of wiring, starters, devices, etc., required.

PART 2 - PRODUCTS

2.1 CORDS AND CAPS

A. Straight-blade Attachment Plug: NEMA WD 1.

B. Locking-blade Attachment Plug: NEMA WD 5.

C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.

D. Cord Construction: Oil-resistant thermoset insulated multi-conductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.

E. Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

2.2 OTHER PRODUCTS

A. Refer to related sections for other product requirements.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that equipment is ready for electrical connection, wiring, and energizing.

3.2 PREPARATION

A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3.3 INSTALLATION

A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.

B. Provide a green equipment ground conductor for all installed equipment wiring.

C. Make conduit connections to equipment using flexible PVC-coated metal conduit.

D. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

E. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.

F. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.

G. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.

3.4 HVAC AND PLUMBING CONNECTIONS

A. Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source through starters, variable frequency drives (VFDs), and disconnects to motors or to packaged control panels. Packaged control panels may include disconnects and starters and overcurrent protection. Provide all wiring between packaged control panels and motors.

B. Contractor shall verify with mechanical contractor the electrical requirements including voltages, horsepower, disconnecting means, starters and variable frequency drives for motors and equipment prior to ordering circuit breakers, disconnects and starters.

C. VFD Installations: Install VFD input wiring and output wiring in separate conduit systems. Do not mix VFD input power and output power, or control wiring in a common raceway. Coordinate

location of VFD in the field. VFD shall be installed where it can be accessed directly without moving other equipment or climbing over it. Location shall be within sight of the equipment it serves.

D. Provide 120 volts to each temperature control panel. Coordinate quantity and exact locations with HVAC/DDC contractors.

E. Unless otherwise specified, all electrical motors and control devices such as aqua-stats, float and pressure switches, fan powered VAV boxes, switches, electro-pneumatic switches, solenoid valves and damper motors requiring mechanical connections shall be furnished and installed and wired by the Contractor supplying the devices.

F. Provide 120V, single phase 15 ampere circuit and switching means to serve factory installed interior lighting within each HVAC unit.

G. Each motor terminal box shall be connected with a minimum 12", maximum 36" piece of flexible PVC-coated metal conduit to a fixed junction box. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.

H. Provide local disconnect within each walk-in HVAC units to serve as line-of-site local motor disconnect. Disconnect enclosure shall be NEMA 4X stainless steel.

I. Check for proper rotation of each motor.

J. All heating, air conditioning and refrigeration equipment installed on the exterior of the building or rooftop shall have a 120V, single phase 20 ampere rated outlet at an accessible location within 25 feet of the equipment.

3.5 ELEVATOR CONNECTIONS

A. Local machine room enclosed circuit breaker.

1. Description: Provide enclosed circuit breaker lockable in the open position in accordance with 2014 NEC 110.25 as indicated on drawing with necessary relay shunt trip controller for elevator shut down prior to sprinkler release. Coordinate shunt trip coil voltage with fire alarm system.

B. Connections

1. Provide all power wiring from source through disconnect to elevator controller to motor.

2. Provide single means of disconnect; manual starter, enclosed circuit breaker or disconnect, labeled "elevator cab lights" located in equipment room Per NEC 620.22. The means of disconnect shall be capable of being locked in the open position. Extend 120 volt circuit from source through lockable switch to controller. Provide one lockable switch and 120 volt circuit per unit. The overcurrent device protecting the branch circuit shall be located in the elevator machine room.

3. Provide 120V, 20 ampere separate branch circuit to serve machine room lighting and receptacle(s) per NEC 620.23. Provide light switch and duplex receptacle (s). A GFCI receptacle shall be located adjacent to elevator motor. Required lighting shall not be connected to load side of GFCI.

4. Provide 120V, 20 ampere separate branch circuit to serve elevator pit lighting and receptacle(s) per NEC 620.24. Required lighting shall not be connected to load side of GFCI.

5. Provide 120V, 20 ampere separate branch circuit to serve elevator pit sump pump. Dedicated circuit shall not be GFCI protected.

6. Provide 120V, 20 ampere separate branch circuits for additional circuits supplying utilization equipment not identified in NEC 620.22, 620.23 and 620.4 but limited to loads per 620.1. Coordinate with elevator manufacturer's requirements. Overcurrent devices protecting these additional loads shall be located in the elevator equipment room.

C. Lighting

1. Provide minimum (2) LED fixtures in elevator pit.

2. Provide switch adjacent to pit access ladder, 36" above door sill. Provide 3-way and 4-way switches, receptacle and lighting on every other floor above lowest level.

3. Provide LED fixtures as required to maintain a minimum of 10 FC throughout the elevator pit.

4. Provide LED fixtures as required to maintain a minimum of 25FC throughout the elevator equipment room or required working clearance around equipment in room-less equipment locations (equipment integral with elevator car).

5. Provide elevator lobby lighting to provide minimum 10 FC at elevator door (s) with the door (s) closed.

D. Misc. connections

1. Provide all wiring for and mount exterior alarm bell.

2. Provide smoke detector in each elevator equipment room or space. Connect main alarm contacts to fire alarm system and auxiliary contacts to the controller.

3. Provide smoke detector in each elevator lobby. Connect main alarm contacts to fire alarm system and auxiliary contacts to elevator controller.

4. All traveling cables, control stations, control station wiring and final control connections at the controller shall be furnished and installed under Division 14 Elevator Work.

5. Provide 3/4" conduit from controller to nearest network wiring closet (IDF) with four pair UTP Cat.-6 or better cable.

6. Coordinate entire installation with Division 14 Contractor prior to rough-in.

7. Coordinate entire installation with Division 27 contractor prior to rough-in for communication and security requirements.

3.6 KITCHEN, DISHWASHING AND LAUNDRY EQUIPMENT CONNECTIONS

A. Check loose equipment delivered to job by equipment installer against approved shop drawings or other required Drawings. Loose electrical equipment including disconnects, starters, thermostats, controls, local and remote switches furnished by equipment contractor shall be installed by electrical contractor.

B. Review dimensioned equipment layouts, detailed shop drawings of equipment, wiring, control and final connection diagrams available from the equipment supplier.

C. Provide fused disconnect switches serving equipment. Equipment installed in damp or wet locations shall be provided with NEMA 4X enclosures.

D. Equipment contractor will receive all equipment and position in place.

E. Electrical Contractor shall rough in for equipment only from approved equipment shop drawings.

F. Rough in location shall be within three inches of equipment. If direct connection is required, use liquid-tight flexible conduit. If receptacle connection is required, verify proper receptacle configuration with equipment installer.

G. Final connections shall include extension of all service to each piece of equipment. All labor and material required to completely connect the equipment ready to operate shall be included in the final connections. All control wiring not integral with equipment shall be included.

H. Provide all required power and control wiring. This may include (but is not limited to) the following:

1. Provide switch in hood and branch circuit for integral light fixtures.

2. Provide pushbutton switch or manual starter for exhaust fan.

3. Provide emergency branch circuit for fire suppression system (if applicable). Wire automatic heat detectors or manual station so, when activated, valve of dry chemical bottle opens, gas solenoid valve shuts down, all dampers close, and make-up fans shut down, electrical power contactor opens (integral in equipment), and building fire alarm system is activated. Provide all required wiring, conduit and final connections. Refer to wiring diagrams supplied with equipment.

4. Provide wash-down system wiring; refer to schematic wiring diagrams supplied with hoods. Interconnect fire prevention system with wash-down system so wash-down system is activated upon alarm.

3.8 MISCELLANEOUS EQUIPMENT

A. For all owner provided equipment, provide final power connection or receptacle at height as directed in the field by the Architect. Coordinate exact receptacle type with selected by the owner.

B. For all equipment provided by others (including stage equipment), coordinate final power connections and receptacles with exact equipment selected. Coordinate clearances, mounting heights, and location before rough-in.

C. In rooms with electrical equipment, during coordination drawings and before rough-in, coordinate clearances and locations of all equipment and major feeders to ensure adequate space. All efforts to ensure equipment shown on the drawings in a space are installed there shall be made.

END OF SECTION 262702

SECTION 262726 - WIRING DEVICES

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. Receptacles, receptacles with integral GFCI, and associated device plates.
2. USB charger devices.
3. Twist-locking receptacles.
4. Receptacles with integral surge-suppression units.
5. Tamper-resistant receptacles.
6. Weather-resistant receptacles.
7. Snap switches and wall-box dimmers.
8. Communications outlets.
9. Cord and plug sets.
10. Floor service outlets.
11. Cord Reels.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. USB Receptacles: One for every 10 of each type installed, but no fewer than two of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).

2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).

3. Leviton Mfg. Company Inc. (Leviton).

4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.

2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), CR5362 (duplex).

b. Hubbell; HBL5351 (single), HBL5352 (duplex).

c. Leviton; 5891 (single), 5352 (duplex).

d. Pass & Seymour; 5361 (single), 5362 (duplex).

B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; TR8300.

b. Hubbell; HBL8300SGA.

c. Leviton; 8300-SGG.

d. Pass & Seymour; TR63H.

2. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.4 USB CHARGER DEVICES

A. Tamper-Resistant, USB Charger Receptacles: 12 V dc, 5 A, USB Type A / USB Type C; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; TRUSBAC20.

b. Hubbell; USB20AC5.

c. Leviton; T5833.

d. Pass & Seymour; TR20USBAC6.

2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.

3. USB Receptacles: (1) Type A; (1) Type C.

4. Line Voltage Receptacles: Dual, two pole, three wire, and self-grounding.

2.5 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed-through type.

2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.

3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; VGF20.

b. Hubbell; GFR5352L.

c. Pass & Seymour; 2095.

d. Leviton; 7590.

C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; GFTR20.

b. Pass & Seymour; 2095TR.

c. Cooper equal

d. Leviton equal.

2.6 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; CWL520R.

b. Hubbell; HBL2310.

c. Leviton; 2310.

d. Pass & Seymour; L520-R.

2.7 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

1) Single Pole:

a) Cooper; AH1221.

b) Hubbell; HBL1221.

c) Leviton; 1221-2.

d) Pass & Seymour; CSB20AC1.

2) Two Pole:

a) Cooper; AH1222.

b) Hubbell; HBL1222.

c) Leviton; 1222-2.

d) Pass & Seymour; CSB20AC2.

3) Three Way:

a) Cooper; AH1223.

b) Hubbell; HBL1223.

c) Leviton; 1223-2.

d) Pass & Seymour; CSB20AC3.

4) Four Way:

a) Cooper; AH1224.

b) Hubbell; HBL1224.

c) Leviton; 1224-2.

d) Pass & Seymour; CSB20AC4.

2.9 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel.

3. Material for Unfinished Spaces: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel.

4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, thermoplastic with weatherproof while in use lockable cover.

2.10 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for UTP cable complying with requirements and one F connector cable TV jack for RG6 coax connection.

2.11 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.

2. Wiring Devices Connected to Emergency Power System: Red.

B. Wall Plate Color: Satin-finished, Type 302 stainless steel.

2.12 CORD REELS

A. Provide 25 foot retractable cable with (2) Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 943, UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; HBLI25123 (white)

b. Reelcraft; equal

c. CoxReel; equal

2. Cord type: SJOW-A/SJO

    a. Length; 25 feet

    b. Conductors; 3 #12 AWG copper

3. Mechanism; Automatic rewind

    a. Adjustable cord stop

    b. Ratchet lock

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.

    b. Straighten conductors that remain and remove corrosion and foreign matter.

c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang boxes and wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Molded-case switches.
5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.

2. Current and voltage ratings.

3. Short-circuit current ratings (interrupting and withstand, as appropriate).

4. Include evidence of NRTL listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

2. Fuse Pullers: Two for each size and type.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect and Owner no fewer than seven days in advance of proposed interruption of electric service.

2. Indicate method of providing temporary electric service.

3. Do not proceed with interruption of electric service without Owner's written permission.

4. Comply with NFPA 70E.

1.11 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

4. Hookstick Handle: Allows use of a hookstick to operate the handle.

5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Hookstick Handle: Allows use of a hookstick to operate the handle.

4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 150A - 250 A.

D. Adjustable, Instantaneous-Trip Circuit Breakers. Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers for breakers larger than 250A: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.

2. Long- and short-time pickup levels.

3. Long- and short-time time adjustments.

4. Ground-fault pickup level, time delay, and I^2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

H. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

I. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.

2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

8. Accessory Control Power Voltage: Integrally mounted, self-powered 120-V ac.

9. Provide handle lockable in the on/off position where required by code.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

2. Outdoor Locations: NEMA 250, Type 3R.

3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.

4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

5. Elevator, Indoor Locations: NEMA 250, Type 4X.

6. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.

c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified.

END OF SECTION 262816

SECTION 265119 - LED INTERIOR LIGHTING

1.1 STIPULATIONS

A. The specifications sections “General Conditions of Contract”, “Special Conditions” and “Division 1 – General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes the following types of LED luminaires:

1. Cylinder.
2. Downlight.
3. Linear industrial.
4. Recessed linear.
5. Strip light.
6. Surface mount, linear.
7. Surface mount, nonlinear.
8. Suspended, linear.
9. Suspended, nonlinear.
10. Materials.
11. Finishes.
12. Luminaire support.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.

2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaires.

4. Include emergency lighting units, including batteries and chargers.

5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.

6. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.

2. Suspended ceiling components.

3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.

4. Structural members to which equipment and or luminaires will be attached.

5. Initial access modules for acoustical tile, including size and locations.

6. Items penetrating finished ceiling, including the following:

   a. Other luminaires.

   b. Air outlets and inlets.

   c. Speakers.

   d. Sprinklers.

   e. Access panels.

   f. Ceiling-mounted projectors.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of luminaire.

E. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Standards:

1. ENERGY STAR certified.

2. California Title 24 compliant.

3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

5. UL Listing: Listed for damp location.

6. Recessed luminaires shall comply with NEMA LE 4.

7. User Replaceable Lamps:

a. Bulb shape complying with ANSI C78.79.

b. Lamp base complying with ANSI C81.61.

C. CRI of minimum 80, CCT as noted in Lighting Fixture Schedule.

D. Rated lamp life of minimum 50,000 hours to L70.

E. Lamps dimmable from 100 percent to 0 percent of maximum light output.

F. Internal driver.

G. Nominal Operating Voltage: as noted on Lighting Fixture Schedule.

1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

H. Housings:

1. Extruded-aluminum housing and heat sink.

2. Clear, or colored, powder-coat or painted finish.

2.2 DOWNLIGHT

A. Maunufacturers: As noted on Lighting Fixture Schedule or approved equal.

B. Minimum 600 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Universal mounting bracket.

D. Integral junction box with conduit fittings.

E. Optics:

1. As noted on Lighting Fixture Schedule or specification sheet.

2.3 LINEAR INDUSTRIAL

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 3000 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Housing and heat sink rated to the following:

1. IP 66.

2.4 RECESSED LINEAR

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 1000 lumens. Minimum allowable efficacy of 85 lumens per watt.

C. Integral junction box with conduit fittings.

2.5 STRIP LIGHT

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 500 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.6 SURFACE MOUNT, LINEAR

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 500 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.7 SURFACE MOUNT, NONLINEAR

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 500 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.8 SUSPENDED, LINEAR

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 1500 lumens. Minimum allowable efficacy of 85 lumens per watt.

2.9 SUSPENDED, NONLINEAR

A. Manufacturers: As noted in Lighting Fixture Schedule or approved equal.

B. Minimum 1500> lumens. Minimum allowable efficacy of 85 lumens per watt.

C. Integral junction box with conduit fittings.

2.10 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.

2. Sheet metal components shall be steel unless otherwise indicated.

3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Tempered Fresnel glass, prismatic glass, diffuse glass, clear glass, prismatic acrylic, or clear, UV-stabilized acrylic.

2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

3. Glass: Annealed crystal glass unless otherwise indicated.

4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum housing and heat sink.

2. Clear or colored, powder-coat or painted finish.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.

b. Lamp diameter, shape, size, wattage, and coating.

c. CCT and CRI for all luminaires.

2.11 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.12 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 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 luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.

3. Provide support for luminaire without causing deflection of ceiling or wall.

4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

1. Secured to outlet box.

2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.

3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.

4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.

2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260923 "Lighting Control Devices."

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.

2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265619 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.

2. Luminaire supports.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.

2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaire.

4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.

5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The

adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

6. Wiring diagrams for power, control, and signal wiring.

7. Photoelectric relays.

8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

C. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of the following:

1. Luminaire.

B. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Source quality-control reports.

D. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.

2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.

2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.

3. Diffusers and Lenses: One for every 100of each type and rating installed. Furnish at least one of each type.

4. Globes and Guards: One for every 20of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.

b. Faulty operation of luminaires and accessories.

c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. UL Compliance: Comply with UL 1598 and listed for wet location.

D. Lamp base complying with ANSI C81.61.

E. Bulb shape complying with ANSI C79.1.

F. CRI of minimum 80. CCT of 4100 K.

G. Lamps dimmable from 100 percent to 0 percent of maximum light output.

H. Internal driver.

I. Nominal Operating Voltage: 277 V ac.

J. Lamp Rating: Lamp marked for outdoor use.

K. Source Limitations: Obtain luminaires from single source from a single manufacturer.

2.2 LUMINAIRE TYPES

A. Area and Site:

1. Mounting: Pole with extruded-aluminum arm,

2. Distribution: See drawings.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2. Glass: Annealed crystal glass unless otherwise indicated.

3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.

2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.

b. Lamp diameter, shape, size, wattage and coating.

c. CCT and CRI for all luminaires.

2.4 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

a. Color: As indicated, poll shall match fixture.

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 luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

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

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Install lamps in each luminaire.

C. Fasten luminaire to structural support.

D. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.

3. Support luminaires without causing deflection of finished surface.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Wiring Method: Install cables in raceways. Conceal raceways and cables.

F. Coordinate layout and installation of luminaires with other construction.

G. Adjust luminaires that require field adjustment or aiming.

H. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with 26 Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

a. IES LM-5.

b. IES LM-50.

c. IES LM-52.

d. IES LM-64.

e. IES LM-72.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires.

END OF SECTION 265619

BARRY ISETT & associates INC

MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 27

Communications

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Optical-fiber-cable pathways and fittings.
3. Metal wireways and auxiliary gutters.
4. Metallic surface pathways.
5. Hooks.
6. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid conduit.

1.4 ACTION SUBMITTALS

A. Product data for the following:

1. Surface pathways
2. Wireways and fittings.
3. Tele-power poles.
4. Boxes, enclosures, and cabinets.
5. Underground handholes and boxes.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; a part of Atkore International.

2. Allied Tube & Conduit; a part of Atkore International.

3. O-Z/Gedney; a brand of Emerson Industrial Automation.

4. Southwire Company.

5. Thomas & Betts Corporation; A Member of the ABB Group.

6. Western Tube and Conduit Corporation.

7. Wheatland Tube Company.

C. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2. Comply with TIA-569-D.

D. GRC: Comply with ANSI C80.1 and UL 6.

E. ARC: Comply with ANSI C80.5 and UL 6A.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. MonoSystems, Inc.

2. Panduit Corp.

3. Wiremold/Legrand.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

E. Galvanized steel.

F. J shape.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlon; a brand of Thomas & Betts Corporation.

2. Crouse-Hinds, an Eaton business.

3. Hoffman; a brand of Pentair Equipment Protection.

4. O-Z/Gedney; a brand of Emerson Industrial Automation.

5. Quazite: Hubbell Power Systems, Inc.

6. RACO; Hubbell.

7. Spring City Electrical Manufacturing Company.

8. Thomas & Betts Corporation; A Member of the ABB Group.

9. Wiremold/Legrand.

C. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-D.

2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.

3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

4. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.

5. Gangable boxes are allowed.

D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

H. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT or RNC.

2. Exposed, Not Subject to Severe Physical Damage: EMT RNC identified for such use.

3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:

   a. Loading dock.

   b. Mechanical rooms.

   c. Multi-purpose room

4. Concealed in Ceilings and Interior Walls and Partitions: EMT or innerduct.

5. Damp or Wet Locations: GRC.

6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.

B. Minimum Pathway Size: 3/4-inch trade size for copper and aluminum cables, and 1 inch for optical-fiber cables.

C. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

E. Install surface pathways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.

2. NECA/BICSI 568.

3. TIA-569-D.

4. NECA 101

5. NECA 102.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

E. Complete pathway installation before starting conductor installation.

F. Arrange stub-ups so curved portions of bends are not visible above finished slab.

G. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT or RMC for pathways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

L. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

M. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

N. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.

b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.

c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

O. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.

2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.

3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.

4. Space hooks no more than 5 feet o.c.
5. Provide a hook at each change in direction.

P. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements.

Q. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

R. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

S. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

T. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

U. Set metal floor boxes level and flush with finished floor surface.

V. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements.

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

BARRY ISETT & associates INC

MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 31

Earthwork

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping, or sealing site utilities.
7. Temporary erosion and sedimentation control.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site.

1.3 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner and Engineer not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Owner and Engineer written permission.

3.3 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Grind down stumps and remove roots larger than 3 inches (75 mm) in diameter, obstructions, and debris to a depth of 18 inches (450 mm) below exposed subgrade.

2. Use only hand methods or air spade for grubbing within protection zones.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

3.4 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth indicated on Drawings in a manner to prevent intermingling with underlying subsoil or other waste materials.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, turf and grasses and plants.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks .
5. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, will be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at project site.

1.4 INFORMATIONAL SUBMITTALS

A. Material test reports.

1.5 FIELD CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, or a combination of these groups; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored to comply with local practice or requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches (300 mm) each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree-:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade.

2. Surveying locations of underground utilities for Record Documents.

3. Testing and inspecting underground utilities.

4. Removing concrete formwork.

5. Removing trash and debris.

6. Removing temporary shoring, bracing, and sheeting.

7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.10 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Initial Backfill: Place and compact initial backfill of subbase material satisfactory soil, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Final Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

E. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.11 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.

2. Under walks and pavements, use satisfactory soil material.

3. Under steps and ramps, use engineered fill.

4. Under building slabs, use engineered fill.

5. Under footings and foundations, use engineered fill.

3.12 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.13 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm)] in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.

2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 92 percent.

3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.

4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.14 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).

2. Walks: Plus or minus 1 inch (25 mm) .

3. Pavements: Plus or minus 1/2 inch (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.15 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Shape subbase course and base course to required crown elevations and cross-slope grades.

2. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.

3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.16 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.

2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.17 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform inspections:

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

BARRY ISETT & associates INC

MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Division 32

Exterior Improvements

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Including the following:

1. Walks, non colored.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.

2. All other contract documents including but not limited to drawings.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.

b. Quality control of concrete materials and concrete paving construction practices.

c. Acceptable weather conditions.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

a. Contractor's superintendent.

b. Independent testing agency responsible for concrete design mixtures.

c. Ready-mix concrete manufacturer.

d. Concrete paving Subcontractor.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Material Test Reports: For each of the following:

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Stamped Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests must be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

2. Do not use frozen materials or materials containing ice or snow.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from steel wire into flat sheets.

B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

C. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420); deformed.

E. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A615/A615M, Grade 60 (Grade 420) deformed bars.

F. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, Grade 60 (Grade 420) deformed bars; assembled with clips.

G. Plain-Steel Wire: ASTM A1064/A1064M, as drawn galvanized.

H. Deformed-Steel Wire: ASTM A1064/A1064M.

I. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420) plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A767/A767M, Class I coating. Cut bars true to length with ends square and free of burrs.

J. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

    1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

K. Zinc Repair Material: ASTM A780/A780M.

2.4 CONCRETE MATERIALS

A. Provide materials in accordance with indicated standards of PADOT Pub 408, including but not limited to aggregates, Portland Cement Cementitious Materials, water and admixtures.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

C. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Cementitious Materials: Use non-expansive fly ash, pozzolan cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

1. Fly Ash or Pozzolan: 25 percent.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content, 1-1/2-inch (38-mm) Nominal Maximum Aggregate Size: 5-1/2 percent plus or minus 1-1/2 percent.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).

2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).

3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (13 mm) according to requirements in Section 312000 "Earth Moving."

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

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 INSTALLATION OF STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.

2. Provide tie bars at sides of paving strips where indicated.

3. Butt Joints: Use at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.

5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet (15.25 m) unless otherwise indicated.

2. Extend joint fillers full width and depth of joint.

3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.

4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch (6-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

    a. Tolerance: Ensure that grooved joints are within 3 inches (75 mm) either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

    a. Tolerance: Ensure that sawed joints are within 3 inches (75 mm) either way from centers of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inch (10-mm) radius. Repeat tooling of edges after applying surface finishes.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 INSTALLATION OF DETECTABLE WARNINGS

A. Comply with manufacturer’s written instructions.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing moisture-retaining-cover, curing, curing compound or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 (ACI 117M) and as follows:

1. Elevation: 3/4 inch (19 mm).

2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).

3. Surface: Gap below 10-feet- (3-m-) long; unleveled straightedge not to exceed 1/2 inch (13 mm).

4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.

5. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).

6. Vertical Alignment of Dowels: 1/4 inch (6 mm).

7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.

8. Joint Spacing: 3 inches (75 mm).

9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.

10. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test to be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results to be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.12 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 323300 – SITE FURNISHINGS

PART 1 – GENERAL

1.1 SUMMARY

A. Furnish and install site furnishings as indicated on the Drawings and specified herein, unless otherwise noted.

B. Section Includes:

1. Surface-mounted benches with backs.

2. Anchoring hardware and accessories required for complete installation.

C. Refer to Product Schedule on Drawing DE-1.

1.2 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's product literature, dimensions, materials, finishes, available standard colors, and written installation instructions for the specified benches.

B. Shop Drawings and Anchorage Details: Submit manufacturer's standard bench mounting and anchoring details for review and approval prior to installation. Details shall identify bench attachment points, anchor type and size, required embedment depth, minimum concrete thickness, anchor spacing, minimum distances from concrete edges, and other installation requirements. Proposed anchorage shall be suitable for installation in existing concrete pavement.

C. Finish and Color Samples: Submit manufacturer's standard powder-coated metal finish samples and recycled lumber color samples for written selection and approval by the Owner or Owner's Representative prior to fabrication.

D. Proposed Substitutions: Submit complete product information for proposed equals in accordance with applicable substitution procedures. Proposed substitutions shall meet or exceed the specified materials, dimensions, durability, finish, and installation requirements.

1.3 QUALITY ASSURANCE

A. Manufacturer shall be regularly engaged in the manufacture of commercial-grade site furnishings suitable for exterior public use.

B. Provide benches and mounting components compatible with the manufacturer's standard product construction and installation requirements.

1.4 WARRANTY

A. Provide manufacturer's standard written warranty against defects in materials and workmanship for a minimum period of three (3) years from the date of shipment.

B. Warranty shall cover repair or replacement of defective components in accordance with the manufacturer's standard warranty terms.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, clearly identified packaging. Inspect materials upon delivery and notify the Owner's Representative of damage, defects, or missing components.

B. Replace damaged or defective products prior to installation at no additional cost to the Owner.

C. Store products above ground in a clean, dry, protected location in accordance with manufacturer's written recommendations.

D. Protect factory-applied finishes and recycled lumber components from damage during delivery, storage, handling, and installation.

1.6 CLOSEOUT SUBMITTALS

A. Submit manufacturer's maintenance instructions, cleaning recommendations, replacement parts information, and manufacturer or supplier contact information.

B. Submit manufacturer's written warranty documentation prior to final acceptance, including the applicable warranty commencement and expiration dates.

PART 2 – PRODUCTS

2.1 BENCH WITH BACK – SURFACE MOUNTED

A. Manufacturer: Keystone Ridge Designs, Inc., or approved equal.

B. Product: Robinson Bench with Back, Model RB26.

C. Size: 6'-0" nominal length.

D. Manufacturer Contact Information:

1. Address: 670 Mercer Road, Butler, PA 16001.

2. Phone: (800) 284-8208.

3. Website: www.keystoneridgedesigns.com.

E. Materials and Construction:

1. Provide commercial-grade, fully assembled bench with welded metal frame, cast aluminum legs, and recycled lumber seat and back slats.

2. Recycled lumber shall be manufacturer's standard exterior-grade material suitable for public-use site furnishings and resistant to moisture, rot, and insect damage.

3. Provide manufacturer's standard frame construction, supports, fasteners, and slat attachments for the specified model.

4. Provide complete welded connections where required by manufacturer's standard fabrication methods.

5. Benches with wood or steel slats in lieu of recycled lumber will not be accepted unless specifically approved as a substitution.

F. Powder-Coated Metal Finish:

1. All exposed metal components shall receive manufacturer's factory-applied powder-coated finish suitable for exterior use.

2. Finish shall be selected from manufacturer's current published standard color offerings.

3. Final powder-coated finish color shall be subject to written approval by the Owner or Owner's Representative prior to fabrication.

G. Recycled Lumber Finish and Color:

1. Provide manufacturer's standard recycled lumber slats in a color selected from the manufacturer's available standard color offerings.

2. Submit recycled lumber color samples for written approval by the Owner or Owner's Representative prior to fabrication.

3. Recycled lumber shall have a uniform appearance and be free of visible defects affecting performance or appearance.

H. Anchoring Hardware:

1. Provide manufacturer-approved stainless steel anchors, fasteners, and mounting hardware required to securely surface-mount benches to existing concrete pavement.

2. Anchor type, size, embedment depth, spacing, minimum concrete thickness, and minimum edge distances shall comply with the anchor manufacturer's written installation requirements and approved anchoring details.

3. Anchoring hardware shall be suitable for the verified existing concrete substrate and intended exterior installation.

4. Provide all accessories necessary for a complete and secure installation.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine proposed bench installation areas and verify existing site conditions prior to installation.

B. Verify the thickness, condition, and suitability of existing concrete pavement to accommodate the manufacturer's required bench anchorage, including minimum anchor embedment depths and edge distances.

C. Verify that existing concrete is free of visible deterioration or other conditions that would prevent secure anchorage.

D. Notify the Owner or Owner's Representative of unsuitable conditions or conflicts prior to installation. Do not proceed until such conditions have been resolved.

3.2 INSTALLATION

A. Install benches in accordance with manufacturer's written installation instructions, approved product submittals, and approved anchoring details at locations indicated on the Drawings.

B. Field Location Approval: Contractor shall mark proposed bench locations in the field and obtain written approval from the Owner or Owner's Representative prior to installation.

C. Install benches level, plumb, properly aligned, and securely surface-mounted to existing concrete pavement.

D. Install benches using manufacturer-approved stainless steel anchors in accordance with approved anchoring details and anchor manufacturer's written installation instructions. Maintain required minimum anchor embedment depths, spacing, and distances from concrete edges.

E. Do not drill or install anchors until final bench locations have been approved in writing by the Owner or Owner's Representative and anchoring details have been reviewed and approved.

F. Do not overtighten anchors or damage bench mounting components or existing concrete pavement.

G. Protect existing concrete pavement during installation. Repair damage resulting from installation activities at no additional cost to the Owner.

H. Where existing conditions prevent installation in accordance with approved anchoring requirements, notify the Owner or Owner's Representative and obtain direction prior to proceeding. Do not modify the anchoring system or existing concrete without approval.

3.3 CLEANING AND PROTECTION

A. Clean benches in accordance with manufacturer's written cleaning recommendations. Remove packaging, construction debris, labels not intended to remain, and other foreign materials.

B. Protect metal finishes, recycled lumber slats, and mounting components from damage during delivery, storage, handling, and installation.

C. Repair or replace damaged components in accordance with manufacturer's recommendations and to the satisfaction of the Owner or Owner's Representative.

D. Protect installed benches from damage until final acceptance by the Owner.

END OF SECTION 323300

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seeding (all disturbed areas not receiving sod).

2. Sodding (sod between curb and sidewalk along Walnut St. and S 4th Street as indicated on Drawings).

1.2 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk materials with appropriate certificates.

1.5 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.

1. Spring Planting: April 1 – May 31.

2. Fall Planting: August 15 – October 15.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality: State-certified seed of grass species as listed below for solar exposure.

2. Quality: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:

3. Species as indicated on seeding schedule on drawings.

2.2 TURFGRASS SOD

A. Turfgrass Sod: Certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

B. Turfgrass Species: As indicated on seeding schedule on drawings.

2.3 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.4 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

2.5 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.

2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil.

B. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h).

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

2. Do not use wet seed or seed that is moldy or otherwise damaged.

3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 5 to 8 lb/1000 sq. ft. (2.3 to 3.6 kg/92.9 sq. m) using a slit seeder.

C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:5 with erosion-control blankets installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with slopes not exceeding 1:5 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

F. Protect seeded areas from hot, dry weather or drying winds by applying planting soil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch (4.8 mm) and roll surface smooth.

3.5 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Moisten topsoil layer immediately prior to installation to form a “glue” between the prepared soil and sod.

C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.

2. Trim edge of sod to provide a clean, continuous line along the base lines and pitchers mound as shown on the plan.

D. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.6 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings.

1. Mow to a height of 2 to 3 inches.

D. Turf Postfertilization: Apply no less than two applications of commercial fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1,000 sq. ft. to turf area.

3.7 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).

2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.8 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Shall be applied to treat already-germinated weeds and according to manufacturer's written recommendations prior to final acceptance by a certified / licensed applicator.

3.9 POST TURF INSTALL SOIL TESTING

A. Contractor shall take soil samples for testing prior to closeout after turf has been seeded and sodded.

B. Contractor to apply treatment fertilizer per Testing Laboratory’s recommendations, if required.

3.10 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.11 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded and Sodded Turf: August 30, 2027.

    a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

2. Contractor shall provide a minimum of three (3) mowings after turf planting and shall provide watering. Site water is unavailable to the Contractor so water will need to be brought in.

END OF SECTION 329200

SECTION 329300 – EXTERIOR PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Trees, shrubs, perennials, groundcover, and plants
2. Topsoil placement in planting areas.
3. Mulch and soil amendments.
4. Providing imported topsoil as required.

B. Related Requirements:

1. Section 311000 “Site Clearing” for protection of existing trees, topsoil stripping and stockpiling.
2. Section 312000 “Earthwork” for excavation, filling and rough grading.

1.2 COORDINATION

A. Coordinate planting operations with installation of utilities, site improvements, finish grading, and other Work affecting planting areas.

B. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.3 SUBMITTALS

A. Product Data Submittals: For each product.

1. Plant Materials: Include quantities, sizes, quality, and verified sources for plant materials.
2. Planting Soil Materials: Submit product data and material certifications for imported topsoil, compost, and soil amendments, including laboratory analysis demonstrating compliance with specified requirements.

B. Soil Testing: Contractor shall provide and pay for topsoil testing. The testing agency shall be acceptable to the Architect. Provide test data for the following:

1. pH factor.
2. Mechanical analysis.

3. Percentage of organic content.
4. Recommendations on type and quantity of additives required establishing satisfactory pH factor and supplying nutrients to a satisfactory level of planting.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

D. Maintenance Data: Recommended procedures to be established by Owner for maintenance of landscape work for one full year. Submit before expiration of required maintenance period(s).

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants on projects of similar or larger scope.

1. Installer's Field Supervision: Maintain an experienced full-time super-visor on Project site when work is in progress.

B. Plant Material Inspection: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials. Provide nursery tags on plant material to certify that plant species comply with the Planting Schedule.

C. Plant Material Quality: Provide trees, shrubs, perennials, ornamental grasses, and groundcover of the quantity, size, genus, species, and variety indicated in the Planting Schedule and complying with ANSI Z60.1, where applicable. Provide healthy, vigorous nursery-grown plants, free of disease, insects, and physical defects.

D. Where formal arrangements or consecutive plantings are shown, select plant material for uniform height and spread to provide a consistent appearance.

1. Where formal arrangements or consecutive order of trees or shrubs are shown, select stock for uniform height and spread, and label with number to assure symmetry in planting.

E. Topsoil: Existing topsoil will be stripped and stockpiled as specified in Section 31 11 000 "Site Clearing." In the event there is a shortage of topsoil to complete the work specified then the Contractor shall import topsoil at his expense. Quality of imported topsoil shall be as specified.

1. In the event there is a surplus of topsoil then the Contractor shall deposit and spread the topsoil where directed by the Architect. Excess topsoil shall not be removed from the site without authorization from the Owner.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Trees and Shrubs: Provide freshly dug balled and burlapped trees and shrubs. Do not prune prior to delivery unless otherwise approved by Architect. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery and while at the project site. Do not drop plant stock during delivery and at the job site.

1.6 FIELD CONDITIONS

A. Planting shall be done within the following dates unless otherwise noted: September 15 to November 15 and March 15 to May 15. The Owner and landscape subcontractor may agree, in writing, to planting outside of these dates.

B. Utilities: All underground utility work shall be installed, inspected and approved before operations are started. Field verify utility locations prior to planting layout.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions in accordance with manufacturer's written instructions and warranty requirements.

1.7 WARRANTY

A. Warrant trees, shrubs, perennials, ornamental grasses, groundcover, and other plant materials against defects, including death and unsatisfactory growth.

1. Warranty Period: 12 months from the Date of Substantial Completion.

B. During the warranty period, if the Contractor determines that maintenance practices or site conditions are detrimental to the health or growth of plant materials, the Contractor shall notify the Owner and Architect in writing, identifying the condition and recommending corrective action.

C. Remove and replace plant materials found to be dead or in an unhealthy condition during the warranty period. Make replacements during the next appropriate planting season.

D. Notify the Owner in writing at least 14 calendar days before expiration of the warranty period to arrange for a final inspection

E. Replace plant materials in doubtful condition at the end of the warranty period unless the Architect determines that an extension of the warranty for one full growing season is appropriate.

1.8 PLANT MATERIALS

A. General: Furnish nursery-grown trees, shrubs, and other plants of size, genus, species, variety and other features indicated in Planting Schedule indicated on the Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.

1. Provide balled and burlapped (B&B) deciduous trees. All burlap and twine shall be rottable.

C. Deciduous Shrubs: Provide shrubs of the height or spread shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.

1. Provide balled and burlapped (B&B) or container grown deciduous shrubs as indicated in the planting schedule. All burlap and twine shall be rottable.

D. Coniferous and Broadleafed Evergreens: Provide evergreens of sizes shown or listed. Dimensions indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens, well balanced form, complying with requirements for other size relationships to the primary dimension shown.

1. Provide balled and burlapped (B&B) or container grown evergreen trees or shrubs as indicated in the planting schedule. All burlap and twine shall be rottable.

E. Perennials and Ornamental Grasses: Provide healthy, vigorous, container-grown plants of species, cultivar, size, and container size indicated in the Planting Schedule. Provide plants with well-developed root systems and growth characteristic of species and cultivar. Do not provide root-bound plants or plants with excessive circling roots.

F. Groundcover: Provide healthy, vigorous plants of species, cultivar, size, and container size indicated in the Planting Schedule, with well-developed root systems and free from weeds, disease, insects, and damaged or dead growth.

1.9 SOIL AMENDMENTS

A. Lime: Natural dolomitic limestone containing not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.

B. Commercial Fertilizer: Complete fertilizer of neutral character, with some elements derived from organic sources and containing the following percentages of available plant nutrients:

1. For trees and shrubs, provide fertilizer with not less than 5 percent total nitrogen, 10 percent available phosphoric acid and 5 percent soluble potash.

C. Compost: Provide mature, stable, commercially produced compost consisting of decomposed leaf material, free of weed seeds, pathogens, and deleterious materials.

1. Compost shall be suitable for landscape planting and accompanied by laboratory analysis demonstrating its suitability.

2. Compost shall be thoroughly mixed with topsoil to provide a uniform planting soil mixture.

3. Incorporate compost at 20 percent by volume into topsoil for planting beds, unless otherwise indicated on the Drawings.

D. Planting Additive: Derived from Sea Kelp, Alfalfa Meal, Peat Humus, Poultry Manure, Iron Sulfate and Magnesium Sulfate and used to help prevent shock and minimize loss.

1. Product: dryROOTS®, or approved equal formula.

2. Guaranteed Analysis:

Total Nitrogen (N) 3.0%
2.0% Water Insoluble Nitrogen

1.0% Water Soluble Nitrogen
Available Phosphate (P2O5) 3.0%
Soluble Potash (K2O) 3.0%
Calcium (C) 8.0%
Magnesium (Mg) 0.5%
Iron (Fe) 1.2%

1.10 MULCHES

A. Organic Mulch: Free from deleterious materials, noxious weed seeds and insect life and suitable for top dressing of trees, shrubs, or plants and consisting of the following:

1. Type: Double shredded, aged hardwoods, not decomposed.
2. Color: As selected by the Architect.

1.11 TREE STABILIZATION MATERIALS

A. Stakes and Guys: Rough-sawn, sound, new hardwood, treated softwood, or redwood, free of knots, holes and other defects, 2-by-2-inch nominal by length indicated.

B. Wire Ties and Guys: Provide 2-strand, twisted, pliable galvanized iron wire, not lighter than 12 gauge with zinc-coated turnbuckles.

1. Provide not less than 1/2-inch diameter rubber or plastic hose, cut to required lengths and of uniform color, material, and size to protect tree trunks from damage by wires.

2. Remove stakes and guys at the end of the Warranty Period by the Contractor.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material of liquid such as paint washout, concrete slurry, cement, oils, gasoline, asphalt, or roofing compound has been deposited in soil within planting area.

2. Confirm placed topsoil has been properly amended and prepared. This includes screening/removal of rocks and even incorporation of amendments.

3. Review surface grades and confirm proper grading has been completed.

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

2.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawn areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavation or planting. Make minor adjustments as required.

2.3 PREPARATION OF PLANTING SOIL

A. Screen and clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.

B. Mix specified soil amendments and fertilizers with topsoil at rates specified per soil test results prior to placing. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.

C. Planting soil for trees and shrubs shall consist of one (1) part organic matter to three (3) parts topsoil uniformly mixed.

D. Planting soil for trees and shrubs requiring acid soil shall consist of two (2) parts organic matter to three (3) parts topsoil uniformly mixed. Further amend soil as necessary to obtain a pH level of 5.0-5.5.

E. Mix fertilizer into planting soil at the rate of 0.25 pounds per cubic foot of soil or per rates specified by soil test results.

2.4 PREPARATION OF PLANTING BEDS

A. Loosen subgrade of planting bed areas to a minimum depth of 8 inches using a culti-mulcher or similar equipment. Remove stones measuring over 1-1/2 inches in any dimension. Remove sticks, stones, rubbish, and other extraneous matter.

B. Spread planting soil mixture to minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement. Place approximately one-half of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer, place remainder of the planting soil.

C. Dig beds not less than 8 inches deep and mix with specified soil amendments and fertilizers.

D. Bermed (raised) planting beds shall be formed of all topsoil from top of the plant down to the level of adjoining seeded areas.

2.5 EXCAVATION FOR TREES AND SHRUBS

A. Excavate pits, beds, and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

1. For trees, make excavations a minimum of 12 inches wider on each side than as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill:

    a. Allow for 3-inch thick setting layer of planting soil mixture.

2. For shrubs make excavation a minimum of 6 inches wider on each side than the ball diameter plus an allowance of 3 inches for setting of ball on a layer of compacted backfill.

B. Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.

2.6 PLANTING TREES AND SHRUBS

A. Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as it was before transplanting. Remove burlap from top half of balls; retain on bottoms. Remove all twine entirely from plant root ball. Apply dryROOTS. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately two-thirds full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.

B. Dish top of backfill to allow for mulching.

C. Edge beds with 4-inch deep clean line wedge cut set 90 degrees adjacent to walks or lawn areas and 45 degrees toward planting bed.

D. Mulch pits, trenches, and planted areas. Provide not less than following thickness of mulch, and finish level with adjacent finish grades.

1. Provide 4-inch minimum, and 6-inch maximum thickness of mulch as top dressing. Dish top surface of the mulching to form a 4-inch high temporary "saucer" around each tree and shrub.

2. Keep mulch 2 inches away from plant stems or trunks.

E. Unless directed by the Architect, do not prune, thin out, or shape trees and shrubs.

F. Remove and replace excessively pruned or misformed stock resulting from improper pruning.

G. If directed by the Architect, guy and stake trees immediately after planting, with a minimum of 3 guys and stakes per tree, spaced at 120 degree intervals as per details on the Drawings.

H. If directed by the Architect, provide tree wrap on deciduous trees as indicated on the Drawings.

2.7 MAINTENANCE

A. Begin maintenance immediately after installation of each plant and continue through 90 days after Date of Substantial Completion.

B. Maintain trees, shrubs, perennials, ornamental grasses, and groundcover in a healthy, vigorous condition throughout the maintenance period.

C. Maintenance shall include watering, weeding, cultivating, pruning, resetting plants to proper grades or upright position, maintaining mulch at specified depth, tightening or repairing tree-stabilization materials, controlling insects and disease, and repairing settlement, erosion, or other damage to planting areas.

D. Provide sufficient water to maintain plants and planting soil in a healthy condition. Contractor shall provide labor, equipment, hoses, temporary connections, and other items required for watering during the maintenance period.

E. Remove and replace plants that die or become unhealthy or unacceptable during the maintenance period.

F. Maintain planting beds free of weeds, debris, and dead or damaged plant material.

2.8 CLEANUP AND PROTECTION

A. During landscape work, keep pavements clean and work area in an orderly condition.

B. Contractor shall be responsible for removing all trash and debris from the site daily. Site paving and curbs shall be broom cleaned and power washed at completion of all landscape work.

C. All removed trash and debris and legally disposed of, off-site by the Contractor.

D. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

2.9 INSPECTION AND ACCEPTANCE

A. Upon completion of planting work, request inspection by Architect to determine whether planting work is complete and acceptable.

B. Where inspected planting work does not comply with requirements, replace rejected work and continue required maintenance until reinspected and found acceptable.

C. Plant warranty period begins on Date of Substantial Completion. Contractor’s plant-maintenance obligations shall continue through 90 days after Date of Substantial Completion.

D. At completion of the 90-day maintenance period, planting areas shall be healthy, weed-free, properly mulched, and in an acceptable condition. Correct deficiencies identified at final maintenance inspection.

END OF SECTION 329300

BARRY ISETT & associates INC

MULTI-DISCIPLINE ENGINEERS AND CONSULTANTS

Attachment A

SPECIFICATION

for

ASBESTOS ABATEMENT

at the

MCHA - GOLDEN AGE MANOR

400 WALNUT STREET
ROYERSFORD, PA 19468

Prepared For:

Montgomery County Housing Authority (MCHA)
Rebecca Schaeffer
MCHA Manager of Capital Projects
104 West Main Street, Suite 1
Norristown, PA 19401

Prepared by:

BATTA Environmental Associates, Inc
6 Garfield Way
Newark, DE 19713

October 16, 2026
BEA #1175426

*Prepared by:*_____
Alyssa M. Cartagena /Regional Project Manager

*Reviewed By:*_____
Neeraj K. Batta / Vice President

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ASBESTOS ABATEMENT at MCHA - GOLDEN AGE MANOR, 400 WALNUT STREET, ROYERSFORD, PA

PART I: GENERAL REQUIREMENTS

0.1 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.

B. Notices and Permits

Job Site Notices & Permits

PA Asbestos Abatement and Demolition/Renovation Notification Form
Department of Public Health, Air Management Services – Major Asbestos Permit
PA Department of Labor and Industry Asbestos Supervisor & Worker Licenses
Emergency Planning Procedures
Material Safety Data Sheets for Encapsulant, Glues, Etc.
Prevailing Wage Determination
Subcontractors List
Equal Employment Opportunity

0.2 DESCRIPTION OF WORK

A. The Project name is Asbestos Abatement at the **MCHA – Golden Age Manor**

1. **Project Location:** MCHA - Golden Age Manor, 400 Walnut Street
   Royersford, PA 19152

2. **Owner:** Montgomery County Housing Authority (MCHA)
   104 West Main Street, Suite 1
   Norristown, PA 19401

B. Contract Documents, dated October 16, 2026, were prepared for the Project by Batta Environmental Associates, Inc., Delaware Industrial Park, 6 Garfield Way, Newark, Delaware 19713. Conditions that are indicated on the Contract Documents include, but are not necessarily limited to the following:

1. Asbestos Abatement at the **MCHA – Golden Age Manor.**

2. Any addenda to the Specification.

C. Work to be Performed Prior to Work Under this Contract:

1. Temporary electric panel(s) outside the work area(s) will be installed by a licensed electrician for use on the project.

D. **Work to be Performed Subsequent to Work Under This Contract:** Upon completion of the demolition and asbestos removal the asbestos contractor will ensure the work area and surrounding areas are clear of any project equipment and waste.

E. **The Scope of Work** consists of asbestos abatement for the following materials:

Location	Material	Confirmed / Assumed	Quantity (SF)
1st Floor Community Room	Floor Tile	Confirmed	1,330
	Mastic associated with (a/w) Floor Tile	Confirmed	1,330
1st Floor Kitchen	Floor Tile	Confirmed	343
	Mastic a/w Floor Tile	Confirmed	343
1st Floor Pool Room	Floor Tile	Confirmed	800
	Mastic a/w Floor Tile	Confirmed	800
1st Floor Laundry Room	Floor Tile	Confirmed	550
	Mastic a/w Floor Tile	Confirmed	550
1st Floor Men's Restroom	Ceramic Tile	Non-ACM	70
	Mastic a/w Tile	Confirmed	70
1st Floor Women's Restroom	Ceramic Tile	Non-ACM	70
	Mastic a/w Tile	Confirmed	70
Front Vestibule	Mastic	Assumed	140

F. **Project Schedule:** To be Announced.

G. **Licensing Requirements:** The work will be performed by a Pennsylvania licensed asbestos abatement contractor.

H. **Guidelines**

1. The Contractor shall follow all guidelines covered within this specification and the accompanying drawings. If there is any discrepancy, they shall immediately bring the discrepancies to the attention of the Consultant. If the solution deviates from the published specification or plan, it shall be put into writing and approved by the Consultant.

I. **Contractor Responsibility**

1. The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State, and local regulations pertaining to the protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical

examinations and maintaining medical records of personnel as required by the applicable Federal, State, and local regulations, and shall hold the Owner harmless for failure to comply with any applicable safety or health regulation on the part of themself, their employees, or their subcontractors.

2. All work practices on this project involving asbestos abatement shall be in accordance with the State of Pennsylvania Department of Environmental Protection (DEP) and the Environmental Protection Agency (EPA) standards.

3. The Contractor is responsible for visiting the site and verifying quantities of asbestos containing materials, locations of utilities, and waste out routes prior to submitting a bid.

    a. No work shall be performed if the Contractor believes the work to be performed is a change and/or addition to the work scope outlined in the construction documents without first obtaining a Notice to Proceed (NTP) from the Owner.

4. The Owner shall not be responsible for compensating the Contractor for work performed that is considered a change and/or addition to the construction documents without the issuance of a NTP and/or a written work directive.

5. Project phasing, start and completion dates are subject to change at the discretion of the Owner.

6. The Contractor shall provide all labor, tools, materials and scaffold necessary to complete the project safely, in a timely fashion, and in accordance with the specification and all applicable regulations.

    a. All tools, ladders, equipment, etc. shall arrive at the project site in good condition and free of any visual residual asbestos contamination.

7. Any movable items remaining in the scheduled work areas at the time of the mobilization of the Contractor shall be removed by the Contractor.

8. The Contractor shall protect all non-movable furniture, cabinetry and equipment from damage throughout the duration of this project.

9. The Contractor shall supply, at their own expense, all construction materials, supplies, and all electrical, water, and waste connections, tie-

ins, or extensions. Temporary service lines shall be installed to prevent tripping, slipping or falling. The Contractor must utilize a licensed electrician to install separate temporary electric panels, receptacles, and lights, all with ground fault interruption and current-overload protection. All temporary electrical set-ups shall be in accordance with OSHA regulation and NEMA standards.

10. The Contractor shall maintain current copies of certifications for workers on-site and shall keep copies of all pertinent specifications and regulations on-site. The air monitor retains the right to prohibit work by employees without current certifications.

11. The Contractor shall maintain a detailed sign-in/sign-out log, which must be filled out by every person entering the work area. All entries shall be complete and legible.

12. The Contractor shall be responsible for security of the work site, fire/smoke detection, and maintenance of existing utility systems as it relates to the performance of this project.

13. The Contractor shall provide fire protection in accordance with all State and Local codes. This includes, but is not limited to:

    a. Providing a written fire prevention and emergency action plan.

    b. Providing multi-purpose ABC rated fire extinguishers, and ensure that on-site personnel are aware of the location and proper use of all fire extinguishers and other safety equipment.

    c. Performing a fire watch of the overall work area.

    d. Designating a safety coordinator to implement the above actions. The Contractor's safety coordinator shall be responsible for:

        i. Fire/life safety entries shall be entered into the Contractor's log daily and shall be submitted with the Contractor's final report.
        ii. Daily entries shall include names, dates, duration, problems & corrective actions taken by the fire watch - must be signed by the safety coordinator.

14. Assure protection of AFD exhaust ducts from damage during asbestos

abatement activities.

15. The Contractor Supervisor and Project Monitor (PM) shall perform a visual inspection of the entire floor immediately below all active abatement work areas at the end of each 8-hour shift to verify that no water leaks, fallen material, or any other type of damage has occurred.

    a. If water leaks, fallen material, or any other type of damage has occurred:

        i. all asbestos abatement work shall be halted;
        ii. the Project Monitor (PM) shall immediately notify the Asbestos Project Manager, Construction Manager and Owner for direction and input;
        iii. the source of the leak or damage shall be determined;
        iv. the containment breech issue shall be rectified before any asbestos abatement work will be permitted to continue.

16. During the performance of final cleaning of all surfaces inside the active abatement work area, all horizontal surfaces "outside the work area" shall also be cleaned. This includes the dirty, shower and clean rooms of decontamination chambers attached to the asbestos abatement work area being tested and all immediate surroundings of representative makeup air entering each independent asbestos abatement work area being tested.

J. Owner's Responsibility

1. The Owner shall employ the services of a Project Monitor (PM) to perform asbestos project inspection as defined by Pennsylvania Department of Environmental Protection (PA DEP) and Pennsylvania Department of Labor and Industry (PA L&I).

2. The Owner shall ensure the work areas will be unoccupied prior to abatement activity commencing.

3. The Owner shall make water and electricity available at the site at no cost to the Contractor. The Owner and/or Construction Manager shall notify the Contractor of scheduled system shut downs to ensure no interruptions to the project's engineering controls.

4. The Owner shall be responsible to remove all computers, monitors, printers, all other computer related components, personal effects, books,

or other items deemed too valuable or sensitive to leave in the scheduled work areas to be handled by the Contractor. A list of such items includes:

a. Personal items throughout any previously mentioned work areas;

b. All computers and computer accessories in any previously mentioned work areas;

c. Stored maintenance and building supply items, paper products, paints, cleaners, replacement ceiling tiles and florescent light bulbs, excess furniture, etc. located in any of the work areas scheduled for abatement, demolition and/or cleaning.

d. Any other items deemed appropriate by the Owner.

e. The Owner shall store items in areas not scheduled for asbestos abatement work.

f. The Owner shall send written notices to the appropriate and responsible MCHA personnel informing them of this responsibility and the limit of the Contractor's responsibilities.

g. Any movable items remaining in the scheduled work areas at the time of the mobilization of the Contractor shall be removed by the Contractor.

0.3 QUALITY ASSURANCE

A. **Contractor Qualifications**: The Contractor shall be a firm of established reputation (or if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of workmen skilled in asbestos abatement, and shall have performed this work on previous projects. All contractors must be prequalified by MCHA in order to perform abatement work.

1. Personnel working on asbestos abatement projects in the State of Pennsylvania are required to be licensed through the State of Pennsylvania. All personnel shall be in compliance with the licensing regulations of:

   Department of Labor & Industry
   Bureau of Occupational & Industrial Safety
   651 Boas Street
   Harrisburg, PA 17121-0750

2. Pursuant to NESHAP requirements the Contractor should provide appropriate written notification at least 10 days prior to the start of asbestos abatement work.

Asbestos NESHAP Coordinator (3WC32)
US EPA Region III
Four Penn Center (Main Office)
1600 JFK Boulevard,
Philadelphia, PA 19103-2029

B. Materials and Equipment

1. In procuring all materials and equipment used in this work, it is the Contractor's responsibility to verify the detailed requirements of the specifically named codes and standards and to verify that the items procured for use in this work meet or exceed the specified requirements, and are suitable for their intended use.

C. Owner's Right of Rejection

1. The Owner/Representative reserves the right to reject any materials or equipment incorporated into the work which fails to meet the specified minimum requirements of this specification.

D. Applicable Standards

1. Applicable standards listed in these specifications include, but are not necessarily limited to, standards promulgated by the following agencies and organizations:
    a. 29 CFR 1926.1101 (OSHA);
    b. 29 CFR 1926.501 (OSHA);
    c. 40 CFR Part 61 (NESHAP);
    d. 40 CFR Part 763 (AHERA);
    e. Resource Conservation and Recovery Act (RCRA);
    f. 40 CFR 300-399, EPA Comprehensive Environmental Response Compensation& Liability Act
    g. 42 CFR Part 84 & 30 CFR Part 11 (NIOSH/DHHS respirator standards);
    h. Act 194 & Act 161 (Pennsylvania Department of Labor and Industry);
    i. NADCA ACR 2006 (HVAC System cleaning standards);

j. This Specification.

E. Laboratory Services

1. Codes and Standards

   a. The Asbestos consultant's laboratory shall be responsible for the quality assurance of the project.

   b. Air sampling shall be in accordance with USDOL/OSHA (29 CFR 1926.58).

   c. Laboratory analysis shall be in accordance with NIOSH Method 7402, and/or 7400.

2. Submittals

   a. Promptly process and distribute one (1) copy to the Owner/Representative and one (1) copy to the Contractor.

   b. Prompt reporting is necessary so that modifications to work methods and/or engineering controls will be implemented as soon as possible.

   c. The Asbestos consultant shall verbally notify all concerned parties within twenty-four (24) hours of the results of each test, followed by written notification within three (3) days.

3. Post-Abatement Air Samples

   a. Post-abatement air sampling shall not be done until written notice from the Contractor is received stating that he is ready for the post-abatement samples to be taken.

   b. Should post-abatement air sampling results include a fiber count greater than all applicable standards in the work area, the Contractor shall reclean the work area and re-sampling shall be performed. All costs of the additional samples will be at the Contractor's expense unless otherwise specified in writing and agreed upon in advance.

0.4 GENERAL ABATEMENT PROJECT CONDITIONS

A. Requirements: The asbestos abatement work areas are Non-Friable Projects as defined by the Environmental Protection Agency (EPA) asbestos NESHAP and shall comply with all requirements therein.

1. The Contractor shall have a PA licensed Supervisor on site at all times during asbestos abatement activities. The Contractor shall not perform any abatement activities, including prep, bag-out, and teardown unless a Project Monitor (PM) is on site.

2. The Contractor shall provide a schedule for all work areas listed. The schedule shall be approved by the Owner and Project Monitor (PM) prior to the commencement of work. The schedule shall include dates and timelines for the completion of all work areas listed in addition to proposed crew sizes.

3. The Owner, Project Monitor (PM), and Contractor shall conduct an inspection for existing damages prior to the commencement of work. All parties shall agree in writing on building conditions and list all damaged materials, furnishings, etc.

4. Contractor access shall be confined to the work areas indicated in this Contract. The Contract may be proceeding concurrently with others in the building. The Contractor shall cooperate fully with the other Contractors in expediting the work of all trades, and avoid damage to the work of the other Contractors.

5. The Contractor shall be served with a Stop Work Order by the Project Monitor (PM) when they are in non-compliance with this Contract Specification and/or other pertinent regulations (Refer to *Section L*).

6. The project shall remain halted until all matters identified in the Stop Work Order are corrected.

B. Asbestos Containing Materials

1. The Work of this contract involves activities that will disturb asbestos-containing materials (ACM). The location and type of ACM known to be present at the worksite is set forth in the Schedule of Asbestos-Containing Materials at the end of this section. If any other suspect ACM is found, notify the Owner, or Owner's Representative about the location and quantity of the suspect ACM within 24 hours of the discovery.

C. Asbestos Health Risk

1. Where in the performance of the work, workers, supervisory personnel, subcontractors, or consultants may encounter, disturb, or otherwise function in the immediate vicinity of any identified ACM, take appropriate continuous measures as necessary to protect all building occupants from the risk of exposure to airborne asbestos. Such measures shall include the procedures and methods described herein, and compliance with regulations of applicable federal, state and local agencies.

D. Contractor Use of Premises:

1. **Use of the Site:** Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the work is indicated.

2. **Owner Occupancy:** Allow for Owner occupancy and use by the public.

3. **Driveways and Entrances:** Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

E. Use of the Existing Building: Maintain the existing building in a weather tight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.

1. **Smoking:** Smoking or open fires will not be permitted within the building enclosure or on the premises.

2. **Toilet Rooms:** Except for toilet rooms designated for use by the Contractor's personnel, use of existing toilets within the building by the Contractor's personnel will not be permitted.

F. Occupancy Requirements

1. **Partial Owner Occupancy:** The Owner reserves the right to occupy and to place and install equipment in completed areas of the building prior to Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.

2. The Contractor will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner occupancy.

G. Site Security

1. **Physical Isolation**

   a. The area of asbestos removal shall be totally isolated from portions of the building not involved in the work.

2. **Posting**

   a. The Contractor shall post danger signs meeting the requirements of OSHA 29CFR 1926.58 (g)(l)(ii) at all entrances to the work area and at a sufficient distance from the work area to permit an individual to read the sign and take necessary protective measures to avoid exposure. Additional signs may be necessary following construction of work place barriers.

3. **Personnel**

   a. All workers and authorized personnel shall enter and exit the work area through the worker decontamination enclosure system.

   b. All personnel who enter the work area must sign the entry log, located in the clean room, upon entry and exit.

   c. All personnel, before entering the work area, shall read and be familiar with all posted regulations, personal protection requirements (including work place entry and exit procedures), and emergency procedures.

   d. All personnel shall proceed first to the clean room, remove all street clothes and don the appropriate respiratory equipment (as deemed adequate for the job conditions) and disposable coveralls, with head and foot covering. Hard hats, eye protection and gloves, shall also be utilized, if required. Clean respirators and protective clothing shall be provided and utilized by each person for each separate entry into the work area.

   e. Personnel wearing designated personal protective equipment shall proceed from the clean room through the shower room and equipment room to the main work area.

   f. Before exiting the work area, all personnel shall remove gross

contamination from the outside of the respirators and protective clothing by brushing and/or wet wiping procedures (small HEPA vacuums with brush attachments may be utilized for this purpose; larger machines may tear the suits).

g. Personnel shall proceed to the equipment room where they shall remove all protective equipment except respirators. Deposit disposable clothing into appropriately labeled containers for disposal. Reusable, contaminated footwear shall be stored in the equipment room when not in use in the work area. Rubber boots may be decontaminated at the completion of the abatement for re-use.

h. Still wearing respirators, personnel shall proceed to the shower area, clean the outside of the respirators and their exposed face areas under running water prior to removal of respirator; personnel will then shower with soap to remove residual asbestos contamination. Various types of respirators will require slight modification of these procedures. An air line respirator with HEPA filter protection may be disconnected in the equipment room and worn into the shower. A powered air purifying respirator face-piece will have to be disconnected from the filter/power-pack assembly which is not waterproof, upon entering the shower. A dual cartridge respirator may be worn into the shower. Cartridges must be replaced for each new entry into the work area.

i. After showering and drying, personnel will proceed to the clean room and don clean disposable (and/or launderable) clothing if there will be later re-entry into the work area or street clothes if it is the end of the work shift.

H. Notifications

1. Pursuant to NESHAP requirements the contractor should provide appropriate written notification at least 10 days prior to the start of asbestos abatement work. Three copies with an approved major asbestos permit are to be sent to:

   Asbestos NESHAP Coordinator (3WC32)
   US EPA Region III
   1600 JFK Boulevard,
   Philadelphia, PA 19103-2029

2. The Contractor shall submit written notification of the asbestos abatement project schedule to the local police and fire departments ten (10) days prior to beginning the project.

3. The Owner will provide a minimum of ten (10) calendar days advance notification of intended asbestos abatement to all occupants shall remain posted until the re-occupancy standard is met.

I. Mandatory Meetings / Submittals

1. **Pre-construction meeting** - The Contractor shall attend a pre-construction meeting scheduled by the Owner. The Contractor shall submit to the Owner the following, if not already submitted:

    - Copies of required notifications, insurance, and bonds.
    - Progress schedule

    a. The Contractor shall provide a schedule for all work areas listed. The schedule shall be approved by the Owner and Project Monitor (PM) prior to the commencement of work. The schedule shall include the number of active abatement work areas at any given time, proposed crew sizes, and waiting periods following the delivery of the work area to the API for final visual inspections and clearance testing.

        i. Asbestos Abatement Work plan delineating phasing and preparation of the work site, including intended locations of water and electrical sources, and the intended storage locations for furniture and ceiling mounted light fixtures and other ceiling mounted items. Description of decontamination sequence, removal methods to be used and waste handling.

        ii. Supervisor credentials and delineation of responsibility for work site supervision, including name, telephone number and pager number for both the project manager and the on-site supervisor.

        iii. Worker qualifications, current licenses, fit tests, and medicals. These may be submitted as the crew is selected or changed, however, no workers will be permitted to remain on site without submission and approval of qualifications.

        iv. Safety Data Sheets (SDS) for the materials to be used on the job:

a) Asbestos abatement encapsulant (only encapsulants approved by the Department of Public Health may be used)
b) Heavy-duty polyethylene tape used for sealing fixed objects, the construction of critical barriers, decontamination chambers and floor/wall containments
c) Name of Waste Hauler(s) and disposal site with EPA/DEP identification numbers
d) Name of the firm or competent person performing the CONTRACTORs OSHA required personnel monitoring and the laboratories PAT Certification and Philadelphia Laboratory Certification
e) A detailed *written* description of emergency procedures to be followed in the event of injury or fire. This submittal must include execution procedures, source of emergency assistance (including telephone numbers), and access procedures to be used by emergency personnel

2. **Progress meetings** - Meetings shall be held at the job site at the discretion of the Owner/Construction Manager/Project Monitor to discuss the progress of the work, phasing and other Contractor coordination, work schedule, and any conflicts or problems. The representative of the Contractor must have authorization to speak for and make commitments for the Contractor. The General Contractor (GC) and Asbestos Abatement Contractor shall continuously coordinate to fulfill project milestones and phasing requirements. The Owner will not pay remobilization fees, charges and/or change orders issued by the GC and/or Asbestos Contractor.

J. General Requirements

1. **Documents and Information Required on Site** – The following information MUST be submitted prior to abatement: EPA 10 Day Notification(s), Supervisor and Worker Badges, Current Medical Clearance and Fit Test Records, Work Plan, Safety Procedures, Evacuation Plan, Emergency Phone Numbers, MSDS information, Worker Acknowledgement Certificates, and Equipment Certification.

2. **Badge Requirements** - All workers must have a current State of Pennsylvania, Department of Labor & Industry Asbestos Supervisor or Worker Badge on site in order to work on this project.

3. **PPE for all Removal Activities** – Tyvek or equivalent coveralls/suits with pull over hoods & feet. For all abatement activities minimum PPE will be Half Face HEPA filtered Respirators, Hard Hats, Safety Glasses, Work Gloves, and Work Boots.

4. **Ground Fault Protection** - Contractor shall use GFCI protection on all electrical connections for this Project. The contractor may use a temporary distribution panel with GFCI breakers or outlets, or use 3-wire extension cord with GFCI to connect to existing electrical outlets in facility.

5. **Tools & Equipment** - All tools & equipment must meet OSHA standards or must be removed from site.

6. **Electrical Lights, Tools & Equipment** -Electrical lights, and electrical tools and equipment in the work area shall be water resistant with 3-wires (or a double insulated piece of equipment with a manufacturer's OEM two prong cord if approved for use in damp locations) and equipment in the work area shall be grounded and utilize a GFCI.

7. **Fire Extinguishers** - Contractor shall provide a minimum of one fire extinguisher for every 2,500 SF of containment and one fire extinguisher outside the containment near the decon.

8. **First Aid Kit** – Contractor shall provide a stocked first aid kit in accordance with 29 CFR 1926.

9. **Three Stage Decontamination Unit** - will be constructed with three separate chambers consisting of a Dirty Equipment Room, a Shower Room complete with a functional shower with hot and cold water, soap, shampoo, and towels, and a Clean Room Chamber. The decon chamber shall be large enough to accommodate the number of workers on the project (*one shower per eight workers*).

10. **Danger Signs** -Proper OSHA Danger signs will be posted at all the entrances to the regulated areas.

11. **Decontamination Unit Waste Water** - will be either filtered with a 5 micron filter, or bagged or drummed as asbestos waste.

12. **Waste Bags** - All ACM waste bags must be at least 6-mil in thickness. All ACM waste will be double-bagged, goose necked, sealed with duct tape, and affixed with NESHAP labels prior to placing in waste container.

13. **Stop Work Order** - If at any time the Contractor is found to not be in compliance with the guidelines of this specification then a STOP WORK ORDER may be issued. Work will cease until corrective measures are taken to bring the work practices

back in compliance and work may not continue until approval is granted by the Owner or Owner's representative.

14. **Final Air Test Results** – Final clearance sampling will be in accordance with the federal, state, and local asbestos regulations.

15. **Land Fill & Chain of Custody** - The building owner directs the Contractor to utilize an EPA approved landfill to dispose of the asbestos waste. The Contractor is to provide the Owner with the completed waste manifest / chain of custody as well as the landfill receipts. Transportation and disposal of asbestos waste shall occur within thirty (30) days after removal. Category I non-friable asbestos material that is not in poor condition and is not friable may be disposed of as ID 13C, construction and demolition debris.

16. **Vehicles or Transportation Containers** – All vehicles, transportation containers, and the transportation of asbestos waste will be in accordance with the Pennsylvania Department of Environmental Resources, and EPA regulations.

K. Emergency Planning

1. Emergency planning shall be developed and initiated prior to abatement activities, and all parties involved will be informed.

2. Emergency procedures shall be in written form and prominently posted in the clean change room and equipment room of the worker decontamination area. Everyone prior to entering the work area must read and sign the procedures to acknowledge receipt and understanding of the work site layout, location of emergency exits and emergency procedures.

3. Emergency planning shall include considerations of fire, explosion, toxic atmospheres, electric hazards, slips, trips and falls, confined spaces and heat related injury. Written procedures shall be developed and employee training in these procedures shall be provided.

4. Employees shall be trained in evacuation procedures in the event of work place emergencies:

    a. For non-life threatening situations, employees injured or otherwise incapacitated, shall decontaminate following normal procedures with assistance from fellow workers, if necessary, before exiting the work place to obtain proper medical treatment.

L. Project Monitor (PM) Responsibility

1. The PM shall act as the Owner's representative on the work site to assure and document compliance with this Specification and applicable regulations and to perform all project sampling and analysis required by federal, state, and local regulations.

2. The PM shall be responsible to see that required information and notifications are posted and are accessible for review by all concerned parties.

3. The PM shall keep a daily log documenting the progress and performance of the Contractor over the course of the project.

4. The PM shall perform continuous inspections to monitor the performance of the Contractor and to assure and document compliance with this Specification and applicable regulations. Inspections shall be performed during all phases of the project including verifying compliance with standard operating procedures, checking engineering controls, personal protection and decontamination systems, and handling and disposition of the resulting asbestos waste materials.

5. The PM shall be responsible for performing all project sampling and analysis required by the federal, state, and local requirements.

6. The PM shall routinely perform smoke testing at all critical barriers throughout the performance of asbestos abatement activities until the receipt of acceptable clearance air sample results to verify the integrity of critical barriers and presence of an adequate negative pressure differential.

7. The PM shall notify the Owner if the Contractor is found to be in non-compliance with the technical specifications or those Municipal, State or Federal regulations applicable to this project.

    a. The PM shall serve written notice to the Contractor for all Contractor non-compliance actions.

8. The Contractor Supervisor and PM shall perform a visual inspection of the entire floor immediately below all active abatement work areas at the end of each 8-hour shift to verify that no water leaks, fallen material, or any other type of damage has occurred.

    a. If water leaks, fallen material, or any other type of damage has occurred:

        i. all asbestos abatement work shall be halted

ii. the PM shall immediately notify the Asbestos Project Manager, Construction Manager and Owner for direction and input
iii. the source of the leak or damage shall be determined
iv. the containment breech issue shall be rectified before any asbestos abatement work will be permitted to continue.

9. The PM shall conduct a detailed final inspection to ensure that no visible dust or debris remains on any surfaces. This includes all surfaces inside the abatement work area and all horizontal surfaces in the immediate surroundings of representative makeup air entering each independent asbestos abatement work area being tested.

M. Air Monitoring by the Owner

1. The Owner shall employ the services of an PM perform air monitoring and quality assurance of the Contractor's work practices.

2. The PM shall collect project air samples in accordance federal, state, and local regulations. Project air monitoring during abatement activities shall include samples inside and outside the work area to ensure airborne fiber concentrations remain at acceptable levels. Acceptable airborne fiber concentrations outside the work area shall be < 0.010 f/cc for PCM and < 0.010 s/cc for TEM. Project samples shall be analyzed via Phase Contrast Microscopy (PCM), NIOSH Method 7400.

3. The PM shall provide clearance air sampling:

    a. For Non-Friable Projects, clearance sample quantity is determined by the Project Monitor and shall consist of a minimum of two (2) clearance samples in each individual work area to be collected and analyzed via PCM. Results shall be evaluated in accordance with the re-occupancy standard set forth by the EPA and NESHAP.

4. The Owner shall be responsible for costs incurred for the initial required laboratory work. Any subsequent testing required due to limits exceeded during abatement or any clearance sampling shall be paid by the Contractor. These costs include both labor and analysis.

    a. The PM shall invoice the Owner, on a separate invoice, for all costs relating to labor and analyses resulting from additional testing required due to limits exceeded during abatement or failure of first round clearance sampling.

b. The Contractor's contract amount shall be reduced by an amount equal to the costs for labor and analyses resulting from additional testing required due to limits exceeded during abatement or failure of first round clearance sampling.

5. The PM will conduct daily air monitoring during the project both inside and outside of the work area during the work.

   a. Air monitoring required by OSHA is the responsibility of the Contractor.

6. **Monitoring** of airborne concentrations of asbestos shall be in accordance with 29 CFR 1910.1001, 29 CFR 1926.1101, and ASTM E 849. The Owner's representative shall monitor the airborne concentration of asbestos before starting work to obtain a baseline fiber concentration in the affected areas. Then monitor continuously during the course of the work inside the asbestos work area; outside the work area including outside the entrance to the asbestos work area and at the exhaust opening of the local exhaust system. If monitoring shows airborne concentrations greater than the asbestos control limits, stop all work, correct the conditions causing the excessive levels, and notify the Owner immediately. In addition, the Owner's representative shall conduct final clearance air tests after abatement is completed in accordance with the EPA and NESHAP re-occupancy standards before removal of the enclosure of the asbestos work area.

7. **Final Cleanup and Removal of Enclosure**: The Contractor must notify the PM that the work area is ready for final inspection. The PM will inspect the work area prior to decontamination and removal of the enclosure. Visual observation of asbestos materials, dust or debris is not permitted on any surface in or around the work area. Clean the work area in accordance with EPA approved methods. The Owner's API will perform air sampling for clearance purposes.

N. Stop Work

1. If the Owner or Owner's Representative presents a written stop work order, immediately and automatically conform to that stop work order, while maintaining temporary enclosures and pressure differential. After being presented with a stop work order, immediately initiate the following actions:

   a. Cease all asbestos removal activities, or any other activities that disturbs ACM.

   b. Repair any fallen, ripped or otherwise failed work area isolation

measures.

c. Maintain in operation all work area isolation measures.

d. Maintain all worker protections.

e. Fog the air in the work area with a mist of amended water to reduce airborne fiber levels.

Do not recommence work until authorized in writing by the API.

PART II: MATERIALS & EQUIPMENT

2.1 GENERAL MATERIALS

A. General

1. Deliver all materials in the original packages, containers or bundles bearing the name of the manufacturer and the brand name (where applicable).

2. Store all materials subject to damage, off the ground, away from wet or damp surfaces and under cover, sufficient to prevent damage or contamination. Replacement materials shall be stored outside of the work area until abatement is completed.

3. Damaged, deteriorating or previously used materials shall not be used and shall be removed from the work site and disposed of properly.

4. Polyethylene sheeting for stationary objects shall be a minimum of two (2) layers of six (6) mil poly sheeting. All floors shall be covered with two (2) layers of six (6) mil poly sheeting and shall be used in widths selected to minimize the frequency of joints. Walls shall be covered with one (1) layer of six (6) mil poly.

5. The method of attaching polyethylene sheeting shall be agreed upon in advance by the Contractor and Consultant or his designated representative and selected to minimize damage to equipment and surfaces. Method of attachment may include any combination of duct tape or other waterproof tape, furring strips, spray glue, staples, nails, screws or other effective procedures capable of sealing adjacent sheets of polyethylene under both wet and dry conditions (including the use of amended water).

6. Polyethylene sheeting utilized for worker decontamination enclosure shall be opaque, white or black in color.

7. Special materials required to protect objects in the work area should be detailed (e.g., plywood over carpeting or hardwood floors to prevent damage from scaffolds and falling material).

8. Disposal bags shall be of six (6) mil polyethylene, pre-printed with labels as required by EPA regulation 40 CFR 61.512 (b)(l)(iv) or OSHA requirement 28 CFR 1910.1001 (g)(2)(ii).

9. Disposal drums shall be metal or fiberboard with locking ring tops.

10. Stick-on labels, as per EPA or OSHA requirements for disposal drums.

All disposal bags and disposal drums shall include the following labels:

Name and address of owner of material.
Warning Label:

CAUTION
CONTAINS ASBESTOS FIBERS
AVOID OPENING OR BREAKING CONTAINER
BREATHING ASBESTOS IS HAZARDOUS TO YOUR HEALTH

Provided in accordance with 29 CFR 191 0:1200 (f) of OSHA's Hazard

Communication Standard.

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
BREATHING AIRBORNE ASBESTOS, TREMOLITE,
ANTHOPHYLLITE,
OR ACTINOLITE FIBERS IS HAZARDOUS TO YOUR HEALTH

Provided in accordance with the U.S. Department of Transportation regulation of hazardous waste marking, 49 CFR Parts 171 and 172. Hazardous Substances: Final Rule. Published November 21, 1986 and revised February 17, 1987.

RQ HAZARDOUS
SUBSTANCE
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(ASBESTOS)

1. **Polyethylene**

   a. All plastic sheeting shall be six (6) mil thick and of sufficient size to enclose the area with a minimum number of seams.

2. **Barrier Securing Materials**

   a. All tape shall be a high-quality duct tape of appropriate width suitable for bonding sheet plastic and disposal waste bags and containers. All spray-on adhesive, glue and other barriers or securing material shall also be high quality products.

3. **Lumber**

   a. Lumber utilized for construction on the work site shall be selected by the Contractor; however, all materials will be of appropriate size to provide safety to all personnel and free of all contaminants.

4. **Hand Tools**

   a. All hand tools shall be furnished by the Contractor and shall be properly used by all personnel. Use only hand tools for the removal of asbestos containing materials whenever feasible. Do not use power tools to remove asbestos containing materials unless the tool is equipped with effective HEPA filtered exhaust ventilation systems. All vacuums and other tools must be clean and decontaminated from all residual asbestos debris before being used on this project.

5. **Disposal Containers**

   a. Waste bags for disposal of asbestos materials shall be 6 mil thick, leak-tight plastic bag, pre-labeled in accordance with 29 CFR 1926,1101.

   b. Fiber or Metal Container Drums

      i. Waste bags may be stored inside rigid fiberboard or metal container drums for additional support of the weight of the asbestos waste. All fiberboard or metal container drums shall be thirty (30) gallon capacity and meet all applicable standards.

B. Removal

1. **Sprayers and Pumps**

a. Sprayers with pumps capable of providing five hundred (500) pounds per square inch (psi) at the nozzle tip at a flow rate of two (2) gallons per minute, shall be used for spraying amended water.

2. **Squeegees and Dustpans**

a. The Contractor shall provide rubber dustpans and squeegees for cleanup.

3. **Brushes**

a. Brushes utilized for removing loose asbestos containing material shall have nylon or fiber bristles, not metal.

4. **Amended Water**

a. Use water containing a wetting agent or surfactant with a surface tension of at least 29 dynes per square centimeter of wet ACM at all times during removal operations

5. **Penetrating Encapsulant**

a. Encapsulants shall conform to USEPA requirements, and shall contain no toxic or hazardous substances and no solvent.

2.2 EQUIPMENT

A. High Efficiency Particulate Air (HEPA) Filtration Devices (AFD)

1. HEPA Filtration

a. The Contractor shall have available, air filtering equipment capable of filtering asbestos fibers to 0.3 microns of at least 99.97 percent efficiency and of sufficient quantity and capacity to provide a complete air change within the work area once every fifteen (15) minutes. Such equipment shall exhaust the filtered air so as to maintain negative pressure. Air shall enter through the decontamination chamber and waste exit ports, and exhaust through the HEPA air filtration unit by means of flexible duct leading outside the work area, outside of the building. The air filtering equipment should be positioned at the maximum distance from the

decontamination chamber space will permit. Air flow shall be sufficient to prevent escape of airborne fibers. HEPA air filtration shall be in operation at all times until final air clearance has been achieved.

b. Air pressure levels at the work site shall be maintained at minus 0.02 inches of water and shall operate on a twenty-four (24) hour basis until satisfactory post-abatement air sampling results have been achieved.

c. The pressure differential will be monitored by the Contractor and verified by the PM.

d. HEPA vacuums shall be leak proof to the filter and equipped with HEPA filters, capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter. Filters on the vacuum shall conform to AIHA Z9.2 and UL 586.

B. Respiratory and Personal Protective Equipment

1. The Contractor shall provide approved respirators and protective clothing to all workers. Authorized representatives of the Owner, State or other Government entity who arrive to inspect the work site shall be permitted access to the work area provided the visitor arrives with their own approved respirator. Protective clothing shall be provided to these visitors by the Contractor.

   a. The Contractor shall provide approved respirators to all visitors that can provide proof that a Pulmonary Function Test, Medical exam and chest x-ray has been performed on the visitor, and that a doctor has performed a pulmonary evaluation of the visitor indicating that the visitor has been deemed able to safely wear a respirator.

2. The Contractor shall require that each person entering the work area shall wear an approved respirator and protective clothing. There shall be no exceptions to this rule.

3. Provide respirators, and ensure that they are used as required by 29 CFR 1926.1101 and 1926.103 and the manufacturer's recommendations. Respirators shall be approved by the National Institute for Occupational Safety and Health NIOSH, under the provisions of 42 CFR 84, for use in environments containing airborne asbestos fibers. For air-purifying respirators, the particulate filter shall be high-efficiency particulate air (HEPA). The initial

respirator selection and the decisions regarding the upgrading or downgrading of respirator type shall be made by the Project Designer based on the measured or anticipated airborne asbestos fiber concentrations to be encountered. Half face respirators with HEPA cartridges are the minimum required respiratory protection for abatement related activities on this project.

4. The Contractor shall conduct a qualitative or quantitative fit test for each worker required to wear a respirator. A respirator fit test shall be performed prior to initially wearing a respirator and every 12 months thereafter. If physical changes develop that will affect the fit, a new fit test shall be performed. Functional fit checks shall be performed each time a respirator is put on and in accordance with the manufacturer's recommendation.

5. The Contractor shall establish in writing, and implement a respiratory protection program in accordance with 29 CFR 1926.1101 and 1910.134.

6. All persons performing asbestos abatement work requiring respiratory protection shall be clean shaven and have an unobstructed face mask seal. Only mustaches that do not exceed the corners of the upper lip and sideburns that do not extend below the earlobes are permitted.

7. Provide personnel exposed to asbestos with disposable “non-breathable,” whole body outer protective clothing, head coverings, and gloves. Provide disposable plastic, rubber, or cloth gloves to protect hands.

8. Provide safety eye protection that meets ANSI standards for personnel not utilizing full face respirators during all work activities on this project.

9. Provide hard hats that meet ANSI standards for all personnel working on this project for all types of work activities and whenever in the work area.

10. For containments with an attached three (3) stage decontamination unit, asbestos workers shall wear a single disposable suit including hood and footwear. Before exiting the work area, the workers shall remove their respirator filters and disposable suit in the shower after appropriate wetting. These shall be disposed of as asbestos waste.

11. For containments utilizing a remote decontamination unit, asbestos workers shall wear two (2) disposable coverall suits. Before exiting the work area, the worker shall remove both suits and change into a clean disposable suit in the

one-stage chamber. The worker shall immediately proceed to the remote centralized, decontamination chamber, equipped with a shower and clean room. Dispose of clean suit and respirator cartridges in the centralized decontamination chamber.

C. Scaffolding/Walkways/Hoists/Ladders

1. The Contractor shall use appropriate ladders, scaffolds, lifts, and/or hoists to provide safe access for equipment demolition and removal of ACM. Personnel safety lines and harnesses are required where appropriate.

    a. Fall protection equipment and guidelines shall comply with OSHA Regulation Standards 29 CFR 1926.501.

2. All scaffolding shall be of sound condition and assembled per OSHA requirements on a level, secure base. Scaffolding shall not be overloaded. The scaffolding shall be secured or tied into the building whenever possible. Guardrails consisting of top and mid-rails and toe boards shall always be installed. A post set-up inspection and daily inspections shall be conducted. Scaffold work platforms shall comply with OSHA Regulation Standards 29 CFR 1926.451.

3. All stairs, platforms, catwalks and walking surfaces shall be kept, as is practical, free from obstructions, accumulation of water, and tripping hazards, and where elevated, be protected by OSHA specified top-rails, mid-rails, and toe boards.

4. Ladders of sufficient quantity and of suitable length or height shall be provided. Only electrically non-conductive materials, such as wood or fiberglass, shall be used. Ladders shall be kept in good repair and inspected regularly. Personnel shall be instructed in the proper use of ladders. No structural alterations shall be made to any ladder.

5. All ladders, scaffolds, lifts, and/or hoists shall arrive at the project site in good condition and free of any visual residual asbestos contamination.

6. Any scaffolding used, erected and later dismantled, must be employed in a manner that does not damage the walls or other building surfaces, and is the responsibility of the Contractor.

7. A competent person is required for the installation and inspection of all scaffolding. A competent person is defined as “one who is capable of identifying existing and predictable hazards in the surroundings or working conditions

which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them."

8. Any scaffolding or ladders utilized during the course of this project will be properly decontaminated to the satisfaction of the Project Monitor.

D. Portable Generators

1. Inspect generators prior to taking them to the job site to ensure they are operational and safe. Follow all safety guidelines by the manufacturer while using a generator on the jobsite. Use heavy duty three pronged extension cords and ground fault circuit interrupters (GFCIs) for all electrical connections to the generator. Never refuel the generator while it is running and never use the generator in an enclosed environment or indoors.

PART III: EXECUTION

3.1 PREPARATION

A. Asbestos Abatement Work Plan

Submit a detailed plan of the procedures proposed for use in complying with the requirements of this specification. Include in the plan the location and layout of decontamination areas, the sequencing of asbestos work, the interface of trades involved in the performance of work, methods to be used to assure the safety of building occupants and visitors to the site, disposal plan including location of approved disposal site, and a detailed description of the methods to be employed to control pollution. Expand upon the use of portable HEPA ventilation system, closing out of the building's HVAC system, method of removal to prohibit visible emissions in work area, and packaging of removed asbestos debris. The plan must be submitted at the Pre-Work Meeting and approved by the Owner's representative prior to commencement of work. Include written contingencies for:

1. Fire
2. Accident
3. Power Failure
4. Negative Air System Failure
5. Pipes Break

B. Pre-Inspection

Prior to commencement of work, inspect areas in which work will be performed. Prepare a listing of damage to structure, surfaces, and equipment or of surrounding properties that could be misconstrued as damage resulting from the work. Photograph or videotape existing conditions as necessary to document conditions. Submit to Owner prior to starting work.

C. Temporary Services:

1. Water Service

    a. Water connection (without charge) to Owner’s existing potable water system is the responsibility of the Contractor. Install using vacuum breakers or other backflow preventer as required by local authority. Hot water shall be supplied at a minimum temperature of one hundred (100) degrees Fahrenheit. Supply hot and cold water to the decontamination unit. In addition, water shall be supplied for all work site uses.

    b. Maintain hose connections and outlet valves in leak-proof condition. Where finish work below an outlet might be damaged by spillage or leakage, provide a drop pan of suitable size to minimize the possibility of water damage. Drain water promptly from pans as it accumulates.

2. Electrical Services

    a. Provide a weather-proof, grounded temporary electric power service and distribution system of sufficient size, capacity, and power characteristics to accommodate performance of work during the construction period. Install temporary lighting adequate to provide a sufficient illumination for safe work and traffic conditions in every area of work.

    b. Lock out existing power or through the work area as described below. Unless specifically noted, otherwise existing power and lighting circuits to the work area are not to be used. All power and lighting to the work area and decontamination facilities are to be provided from temporary electrical panel described below.

        i. Lock out power to work area by switching off breakers serving power of lighting circuits in work area. Circuit locking devices shall be used to lock out power to the work area. Lock panel and have all keys under control of the Owner's Designated Representative.

        ii. Lock out power to circuits running through work area wherever possible by switching off breakers serving these circuits. Circuit locking devices shall be used to lock out power to the work area. Sign and date danger tag. Lock panel and turn keys over to the Owner's Representative for control. If circuits cannot be shut down for any reason, label at intervals 4'O" on center of tags reading, "DANGER live electric circuit". "Electrocution hazard".

    c. Provide temporary electrical panel sized and equipped to accommodate all electrical equipment and lighting required by work. Connect temporary panel to existing building electrical system. Protect with circuit breaker or fused disconnect. Locate temporary panel as directed by Owner or Owner's Representative.

    d. Power Distribution System. Provide circuits of adequate size and proper characteristics for each use. In general, run wiring overhead, and rise vertically where wiring will be least exposed to damage from construction operations.

e. Circuit Protection. Protect each circuit with a ground fault circuit interrupter (GFCI) of proper size located in the temporary panel. Do not use outlet type GFCI devices.

f. Temporary wiring in the work area shall be type UF non-metallic sheathed cable located overhead and exposed for surveillance. Do not wire temporary lighting with plain, exposed (insulated) electrical conductors. Provide liquid tight enclosures or boxes for wiring devices.

g. Number of Branch Circuits. Provide sufficient branch circuits as required by the work. All branch circuits are to originate at temporary electrical panel. At minimum, provide the following:

i. One (1) circuit for each HEPA filtered fan unit.

ii. For power tools and task lighting, provide one (1) temporary four-gang outlet for (four [4] outlets per circuit).
   1. One (1) outlet in the work area for each two thousand, five hundred (2,500) square feet of work area.
   2. One (1) outlet at each decontamination unit, located in Equipment Room.

iii. 110-120 Volt, 20 Amp branch circuits with a four-gang outlet for Owner's exclusive use while conducting air sampling.
   1. One (1) in each work area.
   2. One (1) at clean side of each decontamination unit.
   3. One (1) at each exhaust location for HEPA filtered fan units.

iv. 110-120 Volt, 20 Amp branch circuits with 4-gang outlets for Owner's exclusive use while conducting air sampling.

3. Temporary Lighting

a. Lockout. Lock out all existing power to lighting circuits in the work area. Unless specifically noted otherwise, existing lighting circuits to the work area are not to be used. All lighting to the work area and decontamination facilities is to be provided from temporary electrical panel described above.

D. Decontamination Facilities:

1. For non-friable projects, a one-stage decontamination unit shall be constructed and placed at the entrance to the work area, with a two-stage centralized decontamination unit/shower constructed prior to work in any project areas. Decontamination units shall have a sturdy frame comprised of studs or equivalent.

2. One stage decontamination units shall be constructed as described below:

    a. **One-stage unit**:
        i. Interior of the chamber shall be covered with two layers of six (6) mil polyethylene and triple flap airlocks shall be placed at entrance and exit;
        ii. Shall have a sturdy frame comprised of studs or an approved equivalent.
        iii. Shall have danger signs posted at the entrance;
        iv. Workers shall wear double suits while in the work area. Prior to exiting a contaminated work area, the worker shall change into a clean Tyvek suit prior to proceeding to the centralized, two stage, decontamination chamber, equipped with a shower, provided with hot and cold water, and a clean room. Dispose of suit and respirator cartridges in the centralized decontamination chamber.
        v. Shall be accompanied with a two-stage remote decontamination unit that provides hot and cold water for use in the shower room;
        vi. Shower water shall be added to waste materials or pumped through a five (5) micron filter element prior to discharging it to the sanitary sewer or floor drains.

3. Decontamination units shall have a sturdy frame comprised of studs or equivalent.

4. The Contractor shall provide one decontamination chamber for every eight (8) workers.

5. Asbestos abatement shall not commence until the Contractor can demonstrate to the PM that the shower unit is fully operational.

6. **Decontamination Sequence**. Require that all workers and authorized visitors adhere to the following sequence when entering or leaving the work area.

a. All individuals that enter the work area shall sign the entry log, located in the Clean Room, upon each entry and exit.

b. **Entering the Work Area**. Workers enter the Clean Room and remove street clothing, put on clean disposable overalls and respirator, and pass through the Shower Room into the Equipment Room.

   i. Any additional clothing and equipment left in the Equipment Room needed by the worker is to be put on in the Equipment Room.
   ii. Worker proceeds to the work area.

c. **Exiting the Work Area**

   i. Before leaving the work area, require the worker to remove all gross contamination and debris from the outside of the respirator, and protective clothing by wet wiping and HEPA vacuuming.
   ii. The worker then proceeds to the Equipment Room and removes all clothing except protection equipment.
   iii. Extra clothing such as boots, hard hats, goggles, gloves, are to be stored in contaminated end of the Equipment Room.
   iv. Disposable coveralls are placed in a bag for disposal with other material.
   v. Require that decontamination procedures found in Section V be followed by all individuals leaving the work area.
   vi. After showering, the worker moves to the Clean Room and dresses in either new coveralls for another entry or street clothes if leaving.

7. Construction of the decontamination units.

b. **Walls and Ceilings**. Construct airtight walls and ceiling using two (2) layers of polyethylene sheeting, at least six (6) mil in thickness. Attach to existing building components or a temporary framework.

c. **Floors**. Use two (2) layers (minimum) of six (6) mil polyethylene sheeting to cover floors in all areas of the decontamination units. Use only clear plastic to cover floors.

d. **Flap Doors**. Fabricated from three (3) overlapping sheets with openings a minimum of four (4) feet wide. Configure so that sheeting overlaps adjacent surfaces. Weight sheets at bottoms as required so that they quickly close after being released. Put arrows on sheets to indicate direction of overlap and/or travel. Provide a minimum of four (4) feet between entrance and exit of any room. Provide a minimum of four (4) feet between doors.

e. If the decontamination unit is located within a work area, provide the unit with a minimum of 3/4" plywood "ceiling" and walls with polyethylene sheeting, at least six (6) mil in thickness covering the top of the "ceiling" and walls.

f. **Visual Barrier**. Where the decontamination area is immediately adjacent to and within view of occupied areas, provide a visual barrier of opaque polyethylene sheeting at least six (6) mil in thickness so that work privacy is maintained and work procedures are not visible to building occupants. Where the area adjacent to the decontamination area is accessible to the public, construct a solid barrier on the public side of the sheeting to protect the sheeting. Construct the barrier with wood or metal studs covered with a minimum of 1/4" thick hardboard of 1/2" plywood. Where the solid barrier is provided, sheeting need not be opaque.

g. Alternate methods of providing decontamination facilities may be submitted to the Owner's Representative for approval. Do not proceed with any such method(s) without written authorization from the Owner's Representative.

h. **Electrical**. Provide sub-panel at Clean Room to accommodate all removal equipment. Power the sub-panel directly from a building electrical panel box. Connect all electrical branch circuits in decontamination unit and particularly any pumps in the Shower Room to a ground-fault circuit-protection device.

E. General Work Area Preparation

1. The Contractor shall confine their apparatus, the storage of materials, tools, supplies and the activities of their workman to the limits established by the Owner and local ordinances.

2. The Contractor shall assure that building exits are not obstructed and that appropriate safety barriers are established to prevent access by unauthorized persons. The works areas are to be kept neat, clean and safe.

3. The Contractor shall post OSHA specified, asbestos specific danger signs at the entrance to each work area. Such signs shall also be posted when applicable to decontamination chambers, bagout chambers, critical and separation barriers, and waste storage containers.

4. Provide isolation barriers to separate the abatement work areas from the remaining occupied areas of each floor.

5. All necessary building occupants remaining in the building during the asbestos abatement project shall be denied access to the asbestos abatement work area(s) by isolation barriers and/or locked doors.

6. All moveable objects shall be removed from the work area(s). Movable objects shall be wet wiped & HEPA vacuumed prior to their relocation to a clean area.

7. AFDs and HEPA vacuums require different maintenance schedules and attention depending on the model. Check the user's manual to determine and comply with the maintenance, filer replacement, and cleaning requirements of each AFD and HEPA vacuum being used.

    a. At no time shall an AFD be dismantled and the inner HEPA filter replaced while onsite. Removal and replacement of HEPA filters shall be performed offsite.

    b. At no time shall a HEPA vacuum be opened for cleaning/emptying outside the active asbestos abatement work area.

    c. Cleaning/emptying a HEPA vacuum shall be performed inside an active asbestos abatement work area with a minimum negative pressure differential of - 0.02 inches of water column.
        i. Cleaning/emptying of HEPA vacuums shall be performed directly beside an operating AFD exhausting to the exterior.
        ii. HEPA vacuums shall be cleaned/emptied only during gross removal of asbestos and/or equipment demolition. No

HEPA vacuums shall be cleaned/emptied, or opened for any other reason, during final cleaning and/or encapsulation.

8. AFDs and all other supplies and equipment shall arrive at the project site in good condition and free of any visual residual asbestos contamination.

9. Assure HVAC systems associated with, or that pass through any abatement work areas are shut down. Provide appropriate lock and tag out devices at the shut off point of the fan.

10. De-energize the work areas and all conduit running through the work areas.

    a. Appropriate lock and tag out devices shall be installed at the breakers.

    b. The Contractor shall provide a temporary electric panel with ground fault interruption.

    c. The Contractor shall supply sufficient temporary lighting to illuminate the work areas during asbestos abatement and paint stabilization. All active work areas shall be lighted to not less than the minimum illumination intensities listed in OSHA Regulation 29 CFR 1926.56(a), Table D-3 for Indoors: warehouses, corridors, hallways, and exit ways (e.g. - 5-foot candles).

11. Only approved noncombustible or flame-resistant materials shall be used for work area preparation. Polyethylene sheeting shall be certified to conform to NFPA 701.

F. Project Inspections

1. The following inspections must be performed during the project phases indicated:

    a. **Pre-Cleaning** : A visual inspection of all pre-cleaned surface areas must be performed by the Contractor's supervisor and or the Owner's representative. This inspection will occur prior to the installation of polyethylene covering of walls, floors, and other surfaces.

    b. **Post-Removal** : A visual inspection of each work area must be performed following successful clearance air sampling and prior to commencing tear-down. This inspection is to be performed by the Contractor's Supervisor and or the Owner's Representative.

c. **Substantial Completion**: After each project is complete, including any applicable demolition, re-insulation, or cleaning, a final inspection will be performed by the Contractor's Supervisor and or the Owner's Representative before turning the work area over to the Owner.

3.2 REMOVAL

A. Removal Procedures:

No work shall occur without the presence of a Project Monitor (PM) on site contracted directly with the Owner. The following procedures are in accordance with the all federal, state, and local regulations.

1. REMOVAL OF ASBESTOS CONTAINING MATERIALS – Floor Tile and Mastic (all non-friable removal)

a. Install isolation barriers to separate work areas from building occupants whenever work is occurring in or adjacent to occupied areas on the same floor that are not enclosed in walls with lockable entrances unless all building occupants can be removed from the entire floor while the abatement work is occurring. The isolation barriers shall be constructed with wood or equivalent framing and plywood (minimum 3/8" thickness). A lockable door with louvers to allow air flow may need to be installed at the barrier for access to the work area(s).

b. Set up High Efficiency Particulate Air (HEPA) filtered air filtration devices, (AFDs) in the work area and have them running during pre-clean and prep stages. All exhaust from HEPA AFDs must be vented outside the building.

c. Pre-clean the work area prior to installing criticals. Install two (2) distinct layers of 6 mil polyethylene criticals, on all exterior doorways, operable windows, HVAC registers, louvers, sinks, electric panels, mechanical equipment, and any other openings that lead outside the work area.

c. Construct a containment consisting of two (2) layers of 6 mil polyethylene sheeting on the floors (only where there will not be any floor tile removed), walls and ceiling of the work area. The poly sheeting on the floor shall extend twelve (12) inches up the walls. Walls shall be covered with poly sheeting down to the floor level, thus overlapping the floor covering by minimum of (12) inches between the seams of adjacent layers. Install an airlock (3 layers of 6 mil polyethylene overlapping each other sealed at the top and on alternating sides) opening for entry and to allow make up air to enter the enclosure. Install a single stage decontamination chamber where

the workers can remove their outer layer coveralls before proceeding to the next work area or the remote decon located on that floor.

d. The enclosure will have at least one HEPA vacuum or junior HEPA machine (as appropriate for the size of the enclosure) connected the enclosure to establish a negative pressure differential (NPD) within the enclosure. Exhaust from the HEPA machine shall be vented outside the building. The NPD must be demonstrated through smoke testing and sufficient to provide at least two (2) air changes in the enclosure per hour.

d. After the containment is completed, establish proper negative pressure using HEPA AFDs. All monitoring data will be turned into the Owner's representative at the completion of the project. Removal work shall not begin or continue unless an adequate differential pressure is achieved and maintained.

e. The contractor shall follow proper removal procedures at all times in accordance with the US EPA Regulations and Standards including the National Emissions Standards for Hazardous Air Pollutants (NESHAPS), and OSHA Asbestos in Construction Regulations, 1926.1101. All asbestos containing materials shall be continually wetted with amended water during removal procedures. Dry removal of asbestos will not be permitted. (If non-friable removal is not possible all requirements of a friable project must be followed). All Asbestos Containing Materials (ACM) shall be regularly cleaned up and stored in industry standard waste bags, drums with NESHAP labels affixed to them. Asbestos waste shall be double bagged in 6 mil asbestos waste bags or wrapped in two (2) layers of 6 mil polyethylene or equivalent with danger asbestos warnings on the bags and NESHAP / waste generator labels affixed to the bags after being sealed. Asbestos waste material must be adequately wet and the bags shall be goose necked, sealed with duct tape, and wiped clean prior to being removed from the work area. ACM waste will be bagged out of the work area and stored in a lockable container.

f. Any non-asbestos materials such as cabinetry or other building materials that must be removed to access the ACM being removed can be removed first under non-asbestos conditions. If these non-asbestos materials are removed at the same time as the asbestos abatement then they must be treated and disposed of as asbestos-contaminated waste.

g. PPE requirements for removal operations are a minimum of Safety Glasses (unless Full Face Respirators are used), Work Gloves, Work Boots, Half-Face Respirators with HEPA cartridges and two (2) tyvek or equivalent Full Body Coveralls.

h. After complete removal and final cleaning of all asbestos containing materials throughout the work area, the Owner's representative and Contractor's supervisor will inspect the work area. Once the work area passes a visual inspection and contains no visible asbestos debris, then encapsulation of the work area (except the floor areas to avoid adhesion issues with the new floor system) shall occur prior to running final air tests.

i. Final air tests will be performed by the Owner's Project Monitor (PM) in accordance with all federal, state, and local requirements.

B. Work Area Clearance

1. Clearance air sampling will incorporate PCM air sampling techniques as is required for re-occupancy of the work area(s). The Contractor will encapsulate prior to running final clearance samples where feasible. PCM analytical results will be available within 12 hours of sample collection. The minimum number of clearance samples run will be two (2) air samples per work area.

C. Asbestos Waste Disposal

1. **The dropping, lowering, transporting or otherwise moving any open or packaged waste through any shaft during this project is strictly prohibited.** When the asbestos abatement work area is a shaft, asbestos waste must be packaged and lowered in a controlled fashion to the base of the shaft. No dropping of waste in any shaft shall be permitted at any time.

2. Approval must be obtained from the PM prior for temporary storage of any asbestos waste containers or construction debris on site, prior to being loaded into appropriate dumpsters. The waste shall be appropriately packaged according to the type of waste. A polyethylene drop cloth and covering shall be provided and the storage areas restricted by barrier tape and appropriate signage. Asbestos waste containers must be distinctly stored separately from other waste. No long-term storage may occur in these areas.

3. The loading, transportation, and disposal of asbestos waste at the landfill shall occur in accordance with regulatory requirements of NESHAPS and applicable state and local guidelines and regulations.

4. Waste disposal containers shall conform to one of the following:

   a. Two (2) six-mil polyethylene bags, one placed inside the other, separately sealed. The bags shall be carefully closed to minimize dead air space and taped shut.

i. Six-mil polyethylene disposal bags containing asbestos and asbestos contaminated materials shall be placed into a second six-mil polyethylene bag inside an approved bag-out chamber or decontamination chamber while being removed from the work area. **The second bag shall not be applied inside the work area.**

ii. Material first shall be placed into burlap bags or equivalent to prevent edges/corners from tearing or penetrating polyethylene waste bags. The encased material may then be placed in two (2) six mil polyethylene bags, as per *Subsection a* above.

b. One (1) six mil polyethylene sealed bag inside an air and water tight drum.

5. The Contractor shall label asbestos waste with the name of the generator and the location from which the waste was generated.

6. The container used for transporting and disposing of ACM waste shall be clearly and properly labeled as specified in EPA and DOT regulations. In addition to generator labels, containers must carry the following labels:

DANGER **CONTAINS ASBESTOS FIBERS** **AVOID CREATING DUST** **CANCER AND LUNG DISEASE HAZARD**	**CAUTION** **Contains Asbestos Fibers** **Avoid Opening or Breaking Container** **Breathing Asbestos is Hazardous to your Health**
-and	**RQ ASBESTOS 9,NA2212,PG III (ASBESTOS)**

7. During waste load out, post asbestos specific danger signs along the waste disposal route, and on and around the vehicle or dumpster being used to transport the waste off site.

i. Polyethylene drop cloths shall be utilized along routes in which bagged ACM waste is passed through the building. Proposed waste removal route shall be presented to the PM and Asbestos Project Manager for approval prior to performing delivery of asbestos waste material to the intended waste container. The PM must

document the proposed route and the PMs subsequent approval in an activity log.

ii. Waste routes must be approved by the Owner and on-site PM prior to the commencement of work. All waste being transported through the building must be placed in covered/enclosed containers bearing proper warning signs. The waste route must be kept clean.

i. The rolling of waste drums or the dropping of waste bags down stairs is strictly prohibited.
ii. After transport of waste through the building is completed, the Contractor shall wet mop the waste removal route to assure continued cleanliness and removal of any debris associated with the waste transport tasks.

c. All documentation of transportation and disposal transactions such as dump receipts, trip tickets and waste manifests shall be completed and delivered to the Owner for their records.

i. As the work progresses, to prevent exceeding available storage capacity on-site, sealed and labeled containers of asbestos containing waste shall be removed and transported directly to the pre-arranged, approved asbestos disposal location.
ii. Disposal must occur at an authorized site in accordance with regulatory requirements of NESHAPS, and applicable state and local guidelines, and regulations.
iii. All dump receipts, trip tickets, transportation manifests or other documentation of disposal shall be delivered to the Owner/Representative for his records. A recommended record-keeping format utilizes a chain-of-custody form which includes the names and addresses of the Owner/Representative, Contractor, pick-up site, and disposal site, the estimated quantity of the asbestos waste and type of containers used. The form should be signed by the Owner/Representative, the Contractor, and the Disposal Site Operator, as the responsibility for material changes hands. If a separate hauler is employed, his name, address, telephone number and signature should also appear on the form.
iv. Should the Owner not receive a receipt of the waste shipment record within 35 days, the Owner shall

contact the Contractor to determine the status/disposition of the waste.

v. Should the Owner not receive a receipt of the waste shipment record within 45 days, the Owner shall notify the EPA.

d. **Transportation to the Landfill**

i. Once drums, bags and wrapped components have been removed from the work area, they shall be loaded into an enclosed registered truck for transportation.

ii. To avoid back injuries when moving containers, hand trucks, carts and proper lifting techniques are to be utilized. Trucks with lift gates are helpful for raising drums during truck loading.

iii. The enclosed cargo area of the truck shall be free of debris and lined with six (6) mil, polyethylene sheeting to prevent contamination from leaking or spilled containers. Floor sheeting shall be installed first and extend up the side walls. Wall sheeting shall be overlapped and taped into place.

iv. Drums shall be placed on level surfaces in the cargo area and packed tightly together to prevent shifting and tipping. Large structural components shall be secured to prevent shifting and bags placed on top. Do not throw containers into truck cargo area.

v. Personnel loading asbestos containing waste shall be protected by disposable clothing, including head, body and foot protection, and at a minimum, half face, dual cartridge respirators equipped with high efficiency filters shall be utilized.

vi. Any debris or residue observed by the A.P.I. on containers or surfaces leaving the work area, resulting from cleanup or disposal activities, shall be immediately cleaned up using HEPA filtered vacuum equipment and/or wet methods as appropriate.

vii. Large metal dumpsters are sometimes used for asbestos waste disposal. These shall have doors or tops that can be closed and locked to prevent vandalism or other disturbance of the bagged asbestos debris and wind dispersion of asbestos fibers. Unbagged material shall not be placed in these containers, nor shall it be used for non-asbestos waste. Bags shall be placed, not

thrown, into these containers to avoid splitting. Containers will be properly labeled with appropriate signs.

e. **Disposal at a Landfill**

i. Asbestos waste shall be transported directly to an approved landfill and not to a transfer station. Upon reaching the landfill, trucks are to approach the drum location as closely as possible for unloading of the asbestos containing waste.

ii. Bags, drums, and components shall be inspected as they are off-loaded at the disposal site. Material in damaged containers shall be re-packed in empty drums or bags, as necessary. Local requirements may not allow the disposal of asbestos waste in drums. Check with appropriate agency and institute appropriate alternative procedures.

iii. Waste containers shall be placed on the ground at the disposal site, not pushed or thrown out of trucks (weight of wet material could rupture containers).

iv. Personnel off-loading containers at the disposal site shall wear protective equipment consisting of disposable head, body, and foot protection, and at a minimum, half face, dual cartridge respirators equipped with high efficiency filters shall be utilized.

v. Following the removal of all containerized waste, the truck cargo shall be decontaminated using HEPA vacuums and/or sheeting shall be removed of and discarded, along with contaminated cleaning materials and protective clothing, in bags or drums at the disposal site. This is the responsibility of the registered waste hauler.

vi. If landfill personnel have not been provided with personal protective equipment for the disposal operation by the landfill operator, the Contractor shall supply protective and respiratory protection for the duration for this operation, as requested in writing by the landfill operator.

D. Project Closeout

1. After achieving acceptable air sample clearance and dismantling the work area, the Contractor shall be released after the following items are completed:

a. Removal of all temporary signs, labels, tape and glue/tape adhesive residue.

b. Removal of all temporary devices, facilities, and equipment.

c. Cleaning the project site and storage areas of trash, etc.

d. Replacement/repair of any damage.

e. MCHA deems the repair work (if any) is acceptable for re-occupancy.

f. Removal of all waste containers (asbestos, scrap, and construction debris) from site and proper disposal of waste.

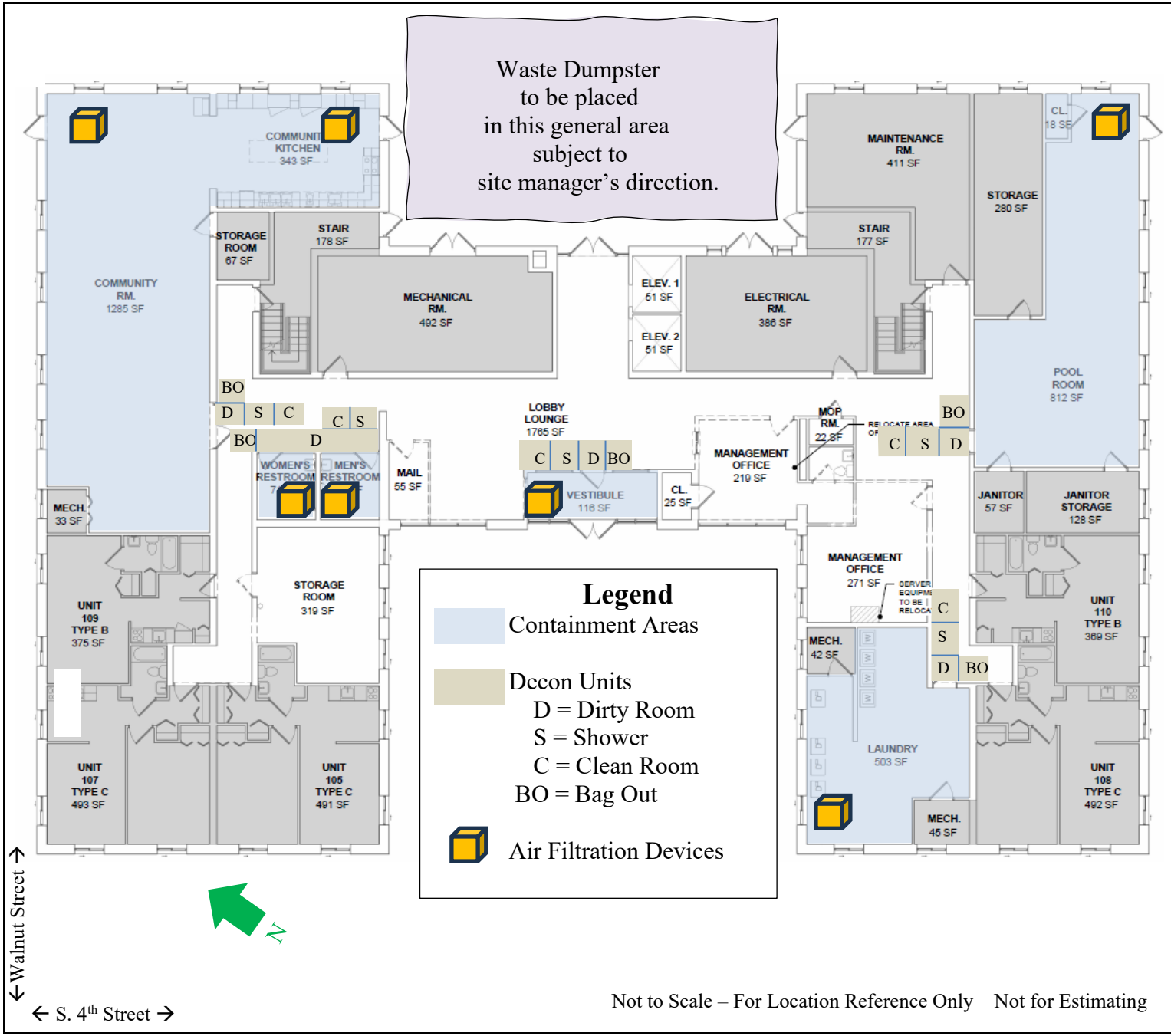
2. Upon completion of the project, the Contractor shall submit final documentation to the Owner, including but not limited to, all waste handling/shipping documentation/manifests.

END OF SPECIFICATION

Asbestos Containing Material
Removal Containment Plans

MCHA
Golden Age Manor

400 Walnut St.
Royersford, PA 19468



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PROJECT TITLE

MCHA
Golden Age Manor

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ASBESTOS CONTAINING MATERIAL REMOVAL CONTAINMENT PLANS

BEA Project #1175426

DATE:	10/22/2026
PROJECT NO.:	1175426
CAD DWG FILE	1175426-01013
DRAWN BY:	TKZ
CHECKED BY:	NKB
DWG NO.:	1175426-1
REVISION: 0	NA
SCALE	NTS