



Project Manual

for

Hampton Inn & Suites

Bair Blvd, New Stanton, PA 15672

Owner: Stanton Hospitality, LLC

Volume I

Divisions 1 through 14

Issued for Construction

July 5, 2017

JMAC Project 16-018

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SECTION 01 10 00 - 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. This Section includes the following:
 - 1. Work covered by the Contract Documents.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Hampton Inn & Suites, Village of Cranberry Woods, Cranberry Woods Dr, Cranberry Twp, PA 16066
- B. Owner: RH Hotels, LP, 215 Executive Drive, Cranberry Township, PA 16066.
- C. Architect: JMAC Architects, 1273 Washington Place, Suite 201, Bridgeville, PA 15017.
- D. Contractor: Franjo Construction Corp., 335 East Seventh Avenue Homestead, PA 15120
- E. The Work consists of the following:
 - 1. The Work includes construction of a new four story Hotel containing 110 Guest Rooms.

1.4 TYPE OF CONTRACT

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

1.5 WORK UNDER OTHER CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1.6 USE OF PREMISES

- A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Driveways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 - 2. Construct construction access from public way or adjoining properties in accordance with the authority having jurisdiction.

1.7 OWNER'S OCCUPANCY REQUIREMENTS

- A. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
 - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
 - 3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. Provide required instructions and operational and maintenance manuals for mechanical and electrical systems serving the occupied areas. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
 - 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.8 WORK RESTRICTIONS

- A. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except otherwise indicated.
- B. Notify the One Call system pursuant to the notification requirements in the regulations before proceeding with excavation or related activities.

- 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 to provide temporary utility services according to requirements indicated:
 - 1. Schedule all approved utility interruption with utility service provider. Obtain permits if required and comply with requirements of the utility company.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 01 25 00 - PRODUCT SUBSTITUTIONS

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. This Section includes administrative and procedural requirements for substitution of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
 - 1. Division 01 Section "References" for applicable industry standards for products specified.
 - 2. Division 01 Section "Product Requirements" for specified products.
 - 3. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
 - 4. Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions are also

products, materials, equipment and methods of construction that replace a previously submitted and approved or approved as noted product.

1.4 SUBMITTALS

- A. Substitution Requests: Submit three hard copies of each request for consideration with one copy sent to the Owner and two copies to the Architect. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form: Use substitution request form at end of this section.
 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - j. Detailed break down of cost and or credit information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 working days of receipt of a request for substitution. Architect will notify Contractor and Owner of acceptance or rejection of proposed substitution within 14 working days of receipt of request, or after receipt of all requested additional information or documentation, whichever is later. When substitution

requests are made beyond the dates established for substitutions, the Architect is not to proceed reviewing the substitution without written direction from the Owner from whence the time for the Architect's review commences.

- a. Form of Acceptance: Change Order.
- b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

1.5 QUALITY CONTROL

- A. Compatibility: Before submitting a substitution request, the Contractor shall conduct a thorough review of the proposed substitute product to ensure that it is compatible with the other products and systems with products previously selected, even if previously selected products were also options.
- B. Verification: Before submitting a substitution request, the Contractor shall verify the proposed substitute product will fit within the space allotted in the originally designed product and that the weight of the substituted product has no adverse affect on the capacity of the supporting structure.
- C. Warranty: Before submitting a substitution request, the Contractor shall confirm the warranty for the proposed substitute product has the same or longer warranty period and the warranty is as comprehensible as the originally specified product.

PART 2 - PRODUCTS

2.1 PRODUCT, MATERIAL, EQUIPMENT AND METHODS OF CONSTRUCTION SUBSTITUTIONS

- A. Timing: After the award of the contract, the Architect will consider requests for substitution if received within 30 calendar days after the Notice to Proceed. Requests presented after 30 days shall be reviewed in the Owner's sole discretion, in which case the Owner will issue a written authorization to the Architect to perform a review of the substitution request.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are demonstrated to the Owner's and Architect's satisfaction. If the following conditions are not so demonstrated, Architect will return requests without action, except to record noncompliance with these requirements:
 1. The request for substitution is properly submitted on the Substitution Request Form at the end of this section.
 2. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 3. Requested substitution does not require extensive revisions to the Contract Documents.

4. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 5. Substitution request is fully documented and properly submitted.
 6. Requested substitution will not adversely affect the Construction Schedule.
 7. Requested substitution has received necessary approvals of authorities having jurisdiction.
 8. Requested substitution is compatible with other portions of the Work.
 9. Requested substitution has been coordinated with other portions of the Work.
 10. Requested substitution provides specified warranty.
- C. Associated Costs: The Contractor shall reimburse the Owner for costs associated with reviewing, evaluating, implementing and coordinating substitution requests and the substitution which shall be incorporated into a change order or backcharged against the Contractor's contract amount if necessary.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SUBSTITUTION REQUEST FORM

TO: _____

FROM: _____

We hereby submit for your consideration the following product instead of the specified item for the above project:

<u>Section</u>		<u>Paragraph</u>		<u>Specified Item</u>
Proposed Substitution:				

Attach complete technical data, including laboratory test, if applicable.

Include complete information on changes to Drawings and/or Specifications which proposed substitution will require for its proper installation.

Fill in blanks below:

A. Does the substitution affect dimensions shown on Drawings?

B. What affect does substitution have on other trades?

C. Differences between proposed substitution and specified item?

D. Manufacturer's guarantees of the proposed and specified items are: ☐ Same ☐ Different (Explain on Attachment)

E. What are the implications of the proposed substitution on the LEEDs requirements for the project?

F. Reason for the substitution?

G. What is the net cost saving if substitution is accepted?

The undersigned hereby confirms that the function, appearance and quality are equivalent or superior to the specified item.

Submitted by:

Signature _____

Firm _____

Address _____

Date: _____

Telephone: _____

For use by Design Consultant

☐ Accepted

☐ Accepted as Noted

☐ Not Accepted

☐ Received too Late

By: _____

Date: _____

Remarks: _____

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
 - 1. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

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

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect 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. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 15 day after receipt of Proposal Request, submit a quotation on the Change Order Proposal Request form accompanied with the corresponding Change Order Proposal Request Supporting Estimate form, that are affixed to the end of this section, estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

- c. Include costs of labor and supervision directly attributable to the change with the exception of projects where there is a full time supervisor and there is no extension to the project schedule, the supervision costs are not to be included.
 - 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 Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect.
 - 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. Provide information on the Change Order Proposal Request form accompanied with the corresponding Change Order Proposal Request Supporting Estimate form that is affixed to the end of this section.
 - 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 with the exception of projects where there is a full time supervisor and there is no extension of the project schedule, the supervision costs are not be included.
 - 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 Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
- C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.5 CHANGE ORDER PROCEDURES

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

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714 form. 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

CHANGE ORDER PROPOSAL REQUEST

COPR # _____

Date: _____

Project: _____ --

Contractor Name and Address: _____

The attached is a compressive and itemized proposal that supports this request for changes in the contract amount and/or time due to modifications the subject Project as described below. Upon approval of this Change Order Proposal Request by the Contractor, Architect and Owner, it will be incorporated into a Change Order. Until the corresponding Change Order is fully executed, this Change Proposal Request is not a valid modification to the Contract.

DESCRIPTION OF THE CHANGE: _____

NOTES: _____

REFERENCE DOCUMENTS: _____

COST SUMMARY:

Item Number	Company Name	Description	Amount

The net amount of this Change Order Proposal Request is a (☐add, ☐deduct, or ☐no change) \$ _____

The net schedule change of the change Proposal Request is a (☐add, ☐deduct, or ☐no change) _____ of calendar days.

Reviewed by (Contractor): _____ Date: _____

Architect Recommendation: ☐Accept ☐Reject ☐Withheld for reason

Reviewed by (Architect): _____ Date: _____

Owner Action: ☐Approved ☐Reject ☐Return to Contractor for revision

(Owner): _____ Date: _____

CHANGE ORDER PROPOSAL REQUEST SUPPORTING ESTIMATE

Project: _____

Change Order Proposal Request # _____

Date: _____

Firm Submitted by: _____

LABOR

	CLASSIFICATION	RATE*	HOURS	EXTENSION
TOTAL				

*Rate includes benefits, taxes and insurance

MATERIAL

DESCRIPTION	QUANTITY	UNITS	UNIT COST**	EXTENSION
TOTAL				

** Unit cost to include applicable sales taxes

EQUIPMENT

DESCRIPTION	QUANTITY	UNITS	RATE***	EXTENSION
TOTAL				

***Rate includes operating cost and owner/rental rates-refer to the Blue Book

RECAP	TOTALS FROM ABOVE
LABOR:	
MATERIAL:	
EQUIPMENT	
SUBTOTAL	
MARK-UP	
TOTAL	
SUBCONTRACTORS	TOTAL FROM THEIR CHANGE ORDER
SUBTOTAL	
MARK-UP	
TOTAL	

SUMMARY

TOTAL OF RECAP		
BOND	%	
B. PRIVLEAGE TAX	%	
GRAND TOTAL		

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment. The allocation used for the schedule of values should be assigned on the basis of value of the work. The Owner may use the value assigned for determining the value of work for the purposed of add or deduct change order.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittals Schedule.
 - c. Contractor's Construction Schedule.
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
2. Submit draft of AIA Document G703 Continuation Sheets.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Include separate line items under required principal subcontracts for operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training in the amount of 5 percent of the Contract Sum.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
6. 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.
7. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: 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: Progress payments shall be submitted to Architect by the tenth of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
- D. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets 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. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 - 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- F. Transmittal: Submit 3] signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of Values.
 - 3. Contractor's Construction Schedule (preliminary if not final).
 - 4. Products list.
 - 5. Submittals Schedule (preliminary if not final).
 - 6. List of Contractor's staff assignments.
 - 7. List of Contractor's principal consultants.
 - 8. Copies of building permits.
 - 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 10. Initial progress report.
 - 11. Report of preconstruction conference.
 - 12. Certificates of insurance and insurance policies.

- I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 - 1. Include documentation supporting position that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Evidence of completion of Project closeout requirements.
 - 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 - 3. Updated final statement, accounting for final changes to the Contract Sum.
 - 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 - 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 - 6. AIA Document G707, "Consent of Surety to Final Payment."
 - 7. Evidence that claims have been settled.
 - 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 - 9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination Drawings.
 - 2. Administrative and supervisory personnel.
 - 3. Project meetings.
 - 4. Requests for Interpretation (RFIs).
- B. Related Sections include the following:
 - 1. Division 01 "Summary of Work"
 - 2. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
 - 3. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 4. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.4 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 1. Preparation of Contractor's Construction Schedule.
 2. Preparation of the Schedule of Values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
 9. Project closeout activities.

1.5 SUBMITTALS

- A. Coordination Drawings: Coordination Drawings for areas of limited space availability and where maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
 1. Content: Project-specific information, drawn accurately to $\frac{1}{4}'' = 1'-0''$ scale, unless approved otherwise by the Architect in writing. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, plumbing, fire protection, data conveyance and electrical systems.
 - b. Indicate required installation sequences.
 - c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
 2. Sheet Size: 30 inches by 42 inches or consistent with the contract documents sheet size.
 3. Number of Copies: Submit three opaque copies of each submittal. Architect will return one copy.

4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, cellular and office telephone numbers. Provide names, addresses, and home, cellular and office telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1.7 PROJECT MEETINGS

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

- j. Submittal procedures.
 - k. Preparation of Record Documents.
 - l. Use of the premises .
 - m. Work restrictions.
 - n. Owner's occupancy requirements.
 - o. Responsibility for temporary facilities and controls.
 - p. Construction waste management and recycling.
 - q. Parking availability.
 - r. Office, work, and storage areas.
 - s. Equipment deliveries and priorities.
 - t. First aid.
 - u. Security.
 - v. Progress cleaning.
 - w. Working hours.
3. Minutes: The Owner or Owner's Representative will record in the form of meeting minutes and distribute to participants.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Owner of meeting at least 14 days in advance.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. The Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.

- x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions in the form of meeting minutes.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present and to the Owner and Architect within 10 days of the meeting.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: The Owner or Owner's Representative will conduct progress meetings at biweekly intervals. Coordinate dates of meetings with preparation of payment requests.
- 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) RFIs.
 - 16) Status of proposal requests.
 - 17) Pending changes.

- 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
 - 21) Schedule status.
3. Reporting: The Owner or Owner's Representative will record, in the form of meeting minutes, and distribute to Attendees, Owner, Architect, Contractor and parties who should have been present but were not.
 4. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.8 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, at a coordination meeting with contractors, or in a shop drawing, prepare and submit an RFI in the form specified.
 1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response. Likewise, incomplete RFI forms will be returned to the Contractor with no response.
 2. The Contractor shall submit its Requests for Interpretation to the Architect as early as possible and in a manner that prioritizes his need for interpretation. Each Request for Interpretation shall be sequentially numbered.
 - a. Requests for Interpretation must be submitted sufficiently in advance of the Work for which the Request for Interpretation is submitted so as to avoid delay to the Project and allow the Architect 10 days to review and respond to such Request for Interpretation. If the Architect determines that a longer time is necessary to respond to the Request for Interpretation, the Architect will notify the Contractor of the anticipated response time within five (5) working days of receipt of the Contractor's Request for Interpretation.
 - b. If the Contractor submits a Request for Interpretation pertaining to an activity where the interpretation is necessary either in less than ten (10) days until the work is scheduled to be performed or in insufficient time to avoid delay, unless the issue is one that was impossible to discover earlier through no fault of the Contractor, the Contractor shall adjust the schedule for the remaining activities to compensate for the delay caused by the timing of the submission of the Request for Interpretation and shall complete the project pursuant to the completion date in the contract, at its own cost and without additional cost to the Owner.
 - c. In the event a response by the Architect is not made in the time set forth in this specification, the Contractor shall immediately notify the Architect in writing of any responses that are needed to avoid delay or extra costs in connection with the project. The Contractor shall not be entitled to any extension of time or additional costs unless such immediate written notification is made.
 3. Requests for Interpretation shall not constitute a request for change order or notice of a claim. The Contractor's requests or claims for additional time or cost shall be evaluated solely on the information submitted in support of a timely submitted request for change order or claim.

4. If the Contractor has submitted a Request for Interpretation that relates to a submittal, including a shop drawing, it shall include such questions on the submittal. The Contractor shall not delay any submittal, including a shop drawing, on the basis of waiting for a response to a Request for Interpretation.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
 1. Project name.
 2. Date.
 3. Name of Contractor.
 4. Name of Architect.
 5. RFI number, numbered sequentially.
 6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 10. Contractor's signature.
 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
- C. Hard-Copy RFIs: Form at end of this Section.
 1. The RFI shall be on the Request for Interpretation electronic form, a copy of which is included at the end of this section. Identify each page of attachments with the RFI number and sequential page number.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow ten working days, or additional time where in the Architect's opinion it is necessary for Architect's response to each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
 1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.

3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log bi-weekly.
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were dropped and not submitted.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

REQUEST FOR INTERPRETATION

Contractor/Trade: _____

Date: _____

To:

cc:

RFI#

Attention:

Email:

Subject/Project Number:

Drawing # _____ Detail # _____

Spec. Sect. _____ Para. _____

Clarification Requested by Contractor

Contractor certifies that this Request does not affect the Project Time Schedule that is already in place. Contractor shall not delay the preparation of submittals on the basis of the RFI, but will incorporate the request into any related submittals where it is impacted.

☐ Attachments by Contractor

Submitted by: _____

Date: _____

Contractor's Interpretation*

*required

Response

☐ Attachments

By: _____

cc: _____ Date: _____

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Submittals Schedule.
 - 3. Daily construction reports.
 - 4. Field condition reports.
- B. Related Sections include the following:
 - 1. Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
 - 2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
 - 3. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
 - 4. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 SUBMITTALS

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

- E. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

1.4 COORDINATION

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

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
 - 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
 - 2. Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 4. Startup and Testing Time: Include not less than 10 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- D. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the commencement of the work.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 3. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.
- B. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
- C. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Principal events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
- D. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.

2.4 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. Equipment at Project site.
 3. Material deliveries.
 4. High and low temperatures and general weather conditions.
 5. Accidents.
 6. Stoppages, delays, shortages, and losses.
 7. Meter readings and similar recordings.
 8. Orders and requests of authorities having jurisdiction.
 9. Services connected and disconnected.
 10. Equipment or system tests and startups.

- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

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

END OF SECTION 013200

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections include the following:
 - 1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
 - 2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
 - 3. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
 - 4. Division 01 Section "Quality Requirements" for submitting test and inspection reports.
 - 5. Division 01 Section "Closeout Procedures" for submitting warranties.
 - 6. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 7. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 8. Division 01 Section "Demonstration and Training" for demonstration of equipment and training of Owner's personnel.
 - 9. Divisions 02 through 49 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

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

1.4 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect 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. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 21 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect 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 14 days for review of each resubmittal.
 - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- E. Identification: Place a permanent label or title block on each submittal for identification.
 - 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 - 2. Provide a space approximately 4 by 5 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 - 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).

- 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.
- F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect
 2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
 1. Transmittal Form.: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Specification Section number and title.
 - i. Drawing number and detail references, as appropriate.
 - j. Transmittal number, Specification section numbered consecutively.
 - k. Submittal and transmittal distribution record.
 - l. Remarks.
 - m. Signature of transmitter.
 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked "Approved" or Approved as Noted."

- J. 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.
- K. Use for Construction: Use only final submittals with mark indicating "Approved" or Approved as Noted" by Architect.
- L. The Contractor shall reimburse the Owner for the cost of the Architect to review individual submittals more than the original review and one subsequent review.
- M. Partial submittals are not acceptable, will be considered non-responsive, and will be returned without review.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. Project data shall be transmitted with the Submittal Review Form that is attached at the end of this section.
 - 2. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 3. Mark each copy of each submittal to show which products and options are applicable.
 - 4. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operation and maintenance manuals.
 - k. Compliance with specified referenced standards.
 - l. Testing by recognized testing agency.
 - m. Application of testing agency labels and seals.
 - n. Notation of coordination requirements.
 - 5. Submit Product Data before or concurrent with Samples.
 - 6. Number of Copies: Submit five copies of Product Data, unless otherwise indicated. Architect will return two copies. Mark up and retain one returned copy as a Project Record Document.

- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.
 - m. Relationship to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer if specified.
 - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 2. Sheet Size: 30 inches by 42 inches.
 3. Number of Copies: Submit two opaque (bond) copies of each submittal. Architect will return one copy.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

- a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 1. Type of product. Include unique identifier for each product.
 2. Number and name of room or space.
 3. Location within room or space.
 4. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
 - a. Mark up and retain one returned copy as a Project Record Document.
- F. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "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. Include the following information in tabular form:
 1. Name, address, and telephone number of entity performing subcontract or supplying products.

2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

- K. Product Test Reports: Prepare 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.
- L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- M. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- N. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- O. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- R. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- S. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
 - 1. Preparation of substrates.
 - 2. Required substrate tolerances.

3. Sequence of installation or erection.
 4. Required installation tolerances.
 5. Required adjustments.
 6. Recommendations for cleaning and protection.
- T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- U. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- V. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.
1. Architect will not review submittals that include MSDSs and will return the entire submittal for resubmittal.
- W. Contractor's written response to Architect's Field Report findings.
- X. Contractor's written response to Special Inspector's findings.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S / ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - 1. "Approved": Proceed with work covered by submittal provided it complied with requirements of Contract Documents; final acceptance will depend upon that compliance.
 - 2. "Approved As Noted": Proceed with work covered by submittal provided it complies with notations or corrections on submittal and requirements of Contract Documents; final acceptance will depend on that compliance.
 - 3. "Revise and Resubmit": Do not proceed with work covered by submittal, including purchasing, fabrication, delivery, or other activity. Revise and/or prepare a new submittal in accordance with notations, and resubmit without delay. Repeat this procedure, if necessary, to obtain a different action mark. Do not use submittals marked "Revise and Resubmit" at the Project site, or elsewhere where work is in progress.
 - 4. "Rejected": Work covered by this submittal is completely unacceptable. Prepare a new submittal and submit without delay.
- C. Two reviews of a submittal item will be considered as the norm. The architect's costs incurred by the contractor's need for additional review is to be paid by the contractor, prior to the additional review taking place.
- D. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- E. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300



Submittal Review Form

Date: Month xx, 201x

To: Conor Magee
Associate
JMAC Architects
1273 Washington Pike, Suite 201
Bridgeville, PA 15017
(412) 257 - 9010

From: Name
Title
Company Name
Address
City State, Zip Code
(XXX) XXX-XXXX

cc:

Project: Hampton Inn & Suites, New Stanton

File No.: 16-018

Submittal No.	Description
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xxx	xxx
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- ☐ Reviewed No Exceptions
- ☐ Reviewed Exceptions Noted
- ☐ Revise & Resubmit
- ☐ Rejected
- ☐ Information Only

Reviewed only for general conformance with the project requirements indicated in Contract Documents and for consistency with the project design concept. This review does not relieve the Contractor from responsibility, for errors or omissions in designs for which the Contractor is responsible for compliance with all requirements of the Contract Documents, and for the safe and successful construction of the work. This review does not consider the means, methods, techniques, sequences, and operations of construction, or safety, precautions or programs incidental thereto, which are the sole responsibility of the Contractor.

Remarks:

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
 - 1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
 - 2. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
 - 3. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

1.4 CONFLICTING REQUIREMENTS

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

1.5 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Description of test and inspection.
 - 3. Identification of applicable standards.
 - 4. Identification of test and inspection methods.
 - 5. Number of tests and inspections required.
 - 6. Time schedule or time span for tests and inspections.
 - 7. Entity responsible for performing tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- C. Reports: Prepare and submit certified written reports that include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.

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

1.6 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar to those indicated for this Project in material, design, and extent.
- F. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- G. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.7 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report concurrently to the Owner, Architect, Architect's subconsultant and Contractor, of each quality-control service.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report concurrently to the Owner, Architect, Architect's subconsultant and Contractor of each test, inspection, and similar quality-control service.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.

7. Testing agency shall execute the Inspection and Testing Agency's Certification form that follows this section.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for the Notice to Proceed.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.
- 1.8 SPECIAL TESTS AND INSPECTIONS
- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
- B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service concurrently to Owner, Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.

5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Installer": Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

- J. "Experienced": When used with an entity, "experienced" means having successfully completed a minimum of **five (5)** previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- K. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
- D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the organizations responsible for the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl1

ADAAG	Americans with Disabilities Act (ADA)	(800) 872-2253
	Architectural Barriers Act (ABA)	(202) 272-0080
	Accessibility Guidelines for Buildings and Facilities	
	Available from Access Board www.access-board.gov	
CFR	Code of Federal Regulations	(866) 512-1800
	Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(202) 512-1800
DOD	Department of Defense Military Specifications and Standards	(215) 697-6257
	Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	
DSCC	Defense Supply Center Columbus (See FS)	
FED-STD	Federal Standard	

(See FS)

FS	Federal Specification Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil Available from Defense Standardization Program www.dps.dla.mil Available from General Services Administration www.gsa.gov Available from National Institute of Building Sciences www.nibs.org	(215) 697-6257 (202) 619-8925 (202) 289-7800
FTMS	Federal Test Method Standard (See FS)	
MIL	(See MILSPEC)	
MIL-STD	(See MILSPEC)	
MILSPEC	Military Specification and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-6257
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

PRIVATE tbl2

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AAADM	American Association of Automatic Door Manufacturers www.aaadm.com	(216) 241-7333
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and	(202) 624-5800

	Transportation Officials www.transportation.org	
AATCC	American Association of Textile Chemists and Colorists (The) www.aatcc.org	(919) 549-8141
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	ACI International (American Concrete Institute) www.aci-int.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHA	American Hardboard Association (Now part of CPA)	
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559

ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)	
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. www.aosaseed.com	(505) 522-1437
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9585
AWCI	AWCI International (Association of the Wall and Ceiling Industry International)	(703) 534-8300

www.awci.org

AWCMA	American Window Covering Manufacturers Association (Now WCSC)	
AWI	Architectural Woodwork Institute www.awinet.org	(800) 449-8811 (703) 733-0600
AWPA	American Wood-Preservers' Association www.awpa.com	(334) 874-9800
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BICSI	BICSI www.bicsi.org	(800) 242-7405 (813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
CCC	Carpet Cushion Council www.carpetcushion.org	(203) 637-1312
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Canadian Electricity Association www.canelect.ca	(613) 230-9263
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462

CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CPA	Composite Panel Association www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association www.cppa-info.org	(800) 510-2772 (202) 462-9607
CRI	Carpet & Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Cast Stone Institute www.caststone.org	(770) 972-3011
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
EJCDC	Engineers Joint Contract Documents Committee www.ejdc.org	(703) 295-5000

EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association www.esda.org	(315) 339-6937
FIBA	Federation Internationale de Basketball Amateur (The International Basketball Federation) www.fiba.com	41 22 545 00 00
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation) www.fivb.ch	41 21 345 35 35
FMG	FM Global (Formerly: FM - Factory Mutual System) www.fmgglobal.com	(401) 275-3000
FMRC	Factory Mutual Research (Now FMG)	
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridarooft.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GRI	(Now GSI)	
GS	Green Seal www.greenseal.org	(202) 872-6400
GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydraulic Institute www.pumps.org	(888) 786-7744 (973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200

HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAS	International Approval Services (Now CSA International)	
IBF	International Badminton Federation www.intbadfed.org	(6-03) 9283-7155
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 255-1561
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
	Available from ANSI www.ansi.org	(202) 293-8020
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (702) 567-8150

ITS	Intertek www.intertek.com	(800) 345-3851 (713) 407-3500
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LMA	Laminating Materials Association (Now part of CPA)	
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864 (804) 314-8955
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Maple Flooring Manufacturers Association, Inc. www.maplefloor.org	(847) 480-9138
MFMA	Metal Framing Manufacturers Association www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6623 (281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAGWS	National Association for Girls and Women in Sport	(800) 213-7193,

ext. 453

www.aahperd.org/nagws/

NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	National Collegiate Athletic Association (The) www.ncaa.org	(317) 917-6222
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-3550
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (303) 697-8441
NFHS	National Federation of State High School Associations www.nfhs.org	(317) 972-6900
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818

NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association) www.nofma.org	(901) 526-5016
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736 (540) 751-0930
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)	
NWWDA	National Wood Window and Door Association (Now WDMA)	
OPL	Omega Point Laboratories, Inc. (Acquired by ITS - Intertek) www.opl.com	(800) 966-5253 (210) 635-8100
PA UCC	Pennsylvania Uniform Construction Code	
PA DOH	Pennsylvania Department of Health	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting & Decorating Contractors of America www.pdca.com	(800) 332-7322 (314) 514-7322
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
PGI	PVC Geomembrane Institute http://pgi-tp.ce.uiuc.edu	(217) 333-3929
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America)	(800) 395-2522 (703) 736-9666

	www.landcarenetwork.org	
PTI	Post-Tensioning Institute www.post-tensioning.org	(602) 870-7540
RCSC	Research Council on Structural Connections www.boltcouncil.org	(800) 644-2400 (312) 670-2400
RFCI	Resilient Floor Covering Institute www.rfci.com	(301) 340-8580
RIS	Redwood Inspection Service www.calredwood.org	(888) 225-7339 (415) 382-0662
RTI	(Formerly: NTRMA - National Tile Roofing Manufacturers Association) (Now TRI)	
SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(516) 294-5424
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234
SIA	Security Industry Association www.siaonline.org	(703) 683-2075
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)	
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smacentral.org	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers www.smpte.org	(914) 761-1100

SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division) www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TCA	Tile Council of America, Inc. www.tileusa.com	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute, Inc. www.tpinst.org	(703) 683-1010
TPI	Turfgrass Producers International www.turfgrassod.org	(847) 649-5555
TRI	Tile Roofing Institute (Formerly: RTI - Roof Tile Institute) www.tilerroofing.org	(312) 670-4177
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association	(972) 243-3902

www.uni-bell.org

USAV	USA Volleyball www.usavolleyball.org	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council www.usgbc.org	(202) 828-7422
USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association (Now WCSC)	
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association) www.windowcoverings.org	(800) 506-4636 (212) 297-2109
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943
WIC	Woodwork Institute of California (Now WI)	
WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 570-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl3

BOCA	BOCA International, Inc. (See ICC)	
IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICBO	International Conference of Building Officials (See ICC)	
ICBO ES	ICBO Evaluation Service, Inc. (See ICC-ES)	
ICC	International Code Council www.iccsafe.org	(888) 422-7233 (703) 931-4533
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543
SBCCI	Southern Building Code Congress International, Inc. (See ICC)	

- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl4

CE	Army Corps of Engineers www.usace.army.mil	
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOD	Department of Defense http://dodssp.daps.dla.mil	(215) 697-6257
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration	(888) 463-6332

www.fda.gov

GSA	General Services Administration www.gsa.gov	(800) 488-3111
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HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
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LBL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-4000
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NCHRP	National Cooperative Highway Research Program (See TRB)	
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NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
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OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
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PBS	Public Building Service (See GSA)	
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PHS	Office of Public Health and Science www.osophs.dhhs.gov/ophs	(202) 690-7694
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RUS	Rural Utilities Service (See USDA)	(202) 720-9540
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SD	State Department www.state.gov	(202) 647-4000
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TRB	Transportation Research Board www.nas.edu/trb	(202) 334-2934
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USDA	Department of Agriculture www.usda.gov	(202) 720-2791
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USPS	Postal Service www.usps.com	(202) 268-2000
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D. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl5

CBHF	State of California, Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation www.dca.ca.gov/bhfti	(800) 952-5210 (916) 574-2041
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CPUC	California Public Utilities Commission	(415) 703-2782
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JMAC Project No. 16-018
Hampton Inn & Suites, New Stanton

July 5, 2017
Issued for Construction

www.cpuc.ca.gov

TFS Texas Forest Service
Forest Resource Development
<http://txforests-service.tamu.edu>

(936) 639-8180

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections include the following:
 - 1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
 - 2. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
 - 3. Division 01 Section "Execution" for progress cleaning requirements.
 - 4. Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.
 - 5. Division 31 Section "Dewatering" for disposal of ground water at Project site.
 - 6. Division 31 Section "Asphalt Paving" for construction and maintenance of asphalt paving for temporary roads and paved areas.
 - 7. Division 32 Section "Concrete Paving" for construction and maintenance of cement concrete pavement for temporary roads and paved areas.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

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

1.6 PROJECT CONDITIONS

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

1.7 CODE COMPLIANCE

- A. All work shall comply with Chapter 33 – Safeguards During Construction of the International Building Code.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pavement: Comply with Division 32 Section "Asphalt Paving." and Section "Concrete Paving."
- B. Chain-Link Fencing: Maximum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) thick, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.
- C. Lumber and Plywood: Comply with requirements in Division 06 Section "Miscellaneous Rough Carpentry."

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including desk and chair for the exclusive use of the Architect, file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack board.
 - 3. Drinking water and private toilet.
 - 4. Coffee machine and supplies.

5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 6. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.3 EQUIPMENT

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

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

- E. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
- G. 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.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
 - 1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine and computer in each field office.
 - 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Architect's office.
 - e. Engineers' offices.
 - f. Owner's office.
 - g. Principal subcontractors' field and home offices.
 - 3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- I. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.
 - 1. Provide DSL in primary field office.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
 - 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
- 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 nor endanger permanent Work or temporary facilities.
- E. Project Identification and Temporary Signs: Provide Project identification and other signs. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
 - 1. Provide temporary, directional signs for construction personnel and visitors.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.
- G. Temporary Elevator Use: Refer to Division 14 Sections for temporary use of new elevators.
- H. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- B. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Division 31 Section "Site Clearing."
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

- F. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 - 1. Prohibit smoking in construction areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

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.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need, or 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.

END OF SECTION 015000

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
 - 1. Division 01 Section "References" for applicable industry standards for products specified.
 - 2. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
 - 3. Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where there is a non identified product, that has the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Acceptance: Change Order.
 - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
- B. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
 - b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
 7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 2. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 3. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
 4. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
 5. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.

6. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
7. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within 20 days after the Notice to Proceed.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 4. Substitution request is fully documented and properly submitted.
 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
 7. Requested substitution is compatible with other portions of the Work.
 8. Requested substitution has been coordinated with other portions of the Work.
 9. Requested substitution provides specified warranty.
 10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.3 COMPARABLE PRODUCTS

- A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 01 73 00 - EXECUTION

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. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.
- B. Related Sections include the following:
 - 1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
 - 2. Division 01 Section "Submittal Procedures" for submitting surveys.
 - 3. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
 - 4. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

3.3 CONSTRUCTION LAYOUT

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

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 4. Maintain minimum headroom clearance of 8 feet (2.4 m) in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

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

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (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: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Warranties.
 - 3. Final cleaning.
- B. Related Sections include the following:
 - 1. Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
 - 2. Division 01 Section "Execution" for progress cleaning of Project site.
 - 3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 4. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 5. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
 - 6. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

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

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

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 2. Execute the "Certificate of Substantial Completion" provided by the Architect.
 3. Submit copy of Contractor's, Owner's and Architect's inspection list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 4. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 5. Submit pest-control final inspection report and warranty.
 6. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 7. Consent of Surety to Final Payment.
 8. Record specifications.
 9. Record submittals.
 10. Record drawings.

11. General warranty.
 12. Testing and balancing agents.
 13. Equipment start-up performance test reports, certified property survey, resolution of claims and allowances.
 14. Manufacturers and/or installers warranties.
 15. Contractor's executed Inspection and Testing Certification
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Concurrent with Request for Substantial Completion, submit two copies and one electronic copy of punch list formatted on the sample form at the end of this section. 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. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect .
 - d. Name of Contractor.
 - e. Page number.

1.6 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within [15] <Insert number> days of substantial completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural

- weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical and electrical equipment [, elevator equipment,] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to unusual operating conditions.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Maintenance manuals for the care and maintenance of products, materials, and finishes systems and equipment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
 - 3. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
 - 4. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. Initial Submittal: Submit 2 draft copies of each manual at least 10 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return one copy of draft and mark whether general scope and content of manual are acceptable.

- B. Final Submittal: Submit 2 copies of each manual in final form at least 10 days before final inspection. Architect will return copy with comments within 10 days after final inspection.
 - 1. Correct or modify each manual to comply with Architect's comments. Submit 2 copies of each corrected manual within 10 days of receipt of Architect's comments.

1.5 COORDINATION

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

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

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

2.2 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.

- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name, address, and telephone number of Contractor.
 6. Name and address of Architect.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.
 2. Performance and design criteria if Contractor is delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.

2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard printed maintenance instructions and bulletins.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."
- G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Sections include the following:
 - 1. Division 01 Section "Closeout Procedures" for general closeout procedures.
 - 2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

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

- B. Record Prints: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect
 - 1. Incorporate changes and additional information previously marked on Record Prints. Erase, redraw, and add details and notations where applicable.
 - 2. Refer instances of uncertainty to Architect for resolution.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2.2 RECORD SPECIFICATIONS

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

2.3 RECORD PRODUCT DATA

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

2.4 MISCELLANEOUS RECORD SUBMITTALS

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

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Project Management and Coordination" for requirements for preinstruction conferences.
 - 2. Divisions 02 through 27 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

- A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. At completion of training, submit two complete training manual(s) for Owner's use.

1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

- B. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
 - 1. Fire-protection systems, including fire alarm, fire pumps and fire-extinguishing systems.
 - 2. Intrusion detection systems.
 - 3. Conveying systems, including elevators.
 - 4. Heat generation, including boilers, feedwater equipment, pumps and water distribution piping.
 - 5. Refrigeration systems, including chillers, pumps and distribution piping.
 - 6. HVAC systems, including air-handling equipment, air distribution systems and terminal equipment and devices.
 - 7. HVAC instrumentation and controls.
 - 8. Electrical service and distribution, including transformers, switchboards, panelboards and motor controls.
 - 9. Packaged engine generators, including transfer switches.
 - 10. Lighting equipment and controls.
 - 11. Communication systems, including intercommunication, voice and data, and television equipment.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.

2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project Record Documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.

7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner with at least seven days' advance notice.
- C. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of performance-based test.

END OF SECTION 017900

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

1.1 SUMMARY

A. Section includes:

1. Cast-in place concrete, including, but not limited to the following:
 - a. Formwork
 - b. Reinforcement
 - c. Concrete materials,
 - d. Mix Design
 - e. Finishes

1.2 REFERENCES

A. [American Association of State Highway and Transportation Officials \(AASHTO\)](#) Publications:

1. M 182

B. [American Concrete Institute \(ACI\)](#) Publications:

1. [ACI](#) 301, "Specification for Structural Concrete."
2. [ACI](#) 117, "Standard Specifications for Tolerances for Concrete Construction and Materials."
3. [ACI](#) 211.1 "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete".
4. [ACI](#) 211.2 "Standard Practice for Selecting Proportions for Structural Lightweight Concrete".
5. [ACI](#) 212 "Chemical Admixtures for Concrete"
6. [ACI](#) 214R "Evaluation of Strength Test Results of Concrete"
7. [ACI](#) 301 "Standard Specification for Structural Concrete"
8. [ACI](#) 302 "Guide for Concrete Floor and Slab Construction"
9. [ACI](#) 304R "Guide for Measuring, Mixing, Transporting and Placing Concrete".
10. [ACI](#) 305R "Hot Weather Concreting".
11. [ACI](#) 306R "Cold Weather Concreting".
12. [ACI](#) 308 "Standard Practice for Curing Concrete"
13. [ACI](#) 309R "Guide for Consolidation of Concrete".
14. [ACI](#) 311.4R "Guide for Concrete Inspection".
15. [ACI](#) 318 "Building Code Requirements for Structural Concrete".
16. [ACI](#) 347R "Guide to Formwork for Concrete".
17. [ACI](#) 544 "Fibers Reinforced Concrete"
18. [ACI](#) SP66 "ACI Detailing Manual".

C. [ASTM International \(ASTM\)](#) Publications:

1. A82 "Standard Specification for Steel Wire, Plain, for Concrete Reinforcement"
2. A184 "Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement"
3. A185 "Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete"
4. A496 "Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement"
5. A497 "Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete"
6. A615 "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"
7. A706 "Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement"
8. A775 "Standard Specification for Epoxy-Coated Steel Reinforcing Bars"
9. A884 "Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement"
10. A934 "Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars"
11. C31 "Standard Practice for Making and Curing Concrete Test Specimens in the Field"
12. C33 "Standard Specification for Concrete Aggregates"
13. C39 "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens"
14. C42 "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete"
15. C94 "Standard Specification for Ready-Mixed Concrete"
16. C109 "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars"
17. C143 "Standard Test Method for Slump of Hydraulic Cement Concrete"
18. C150 "Standard Specification for Portland Cement"
19. C171 "Standard Specification for Sheet Materials for Curing Concrete"
20. C172 "Standard Practice for Sampling Freshly Mixed Concrete"
21. C173 "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method"
22. C219 "Standard Terminology Relating to Hydraulic Cement"
23. C231 "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method"
24. C260 "Standard Specification for Air-Entraining Admixtures for Concrete"
25. C309 "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete"
26. C330 "Standard Specification for Lightweight Aggregates for Structural Concrete"
27. C494 "Standard Specification for Chemical Admixtures for Concrete"

28. C567 "Standard Test Method for Determining Density of Structural Lightweight Concrete"
 29. C618 "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete"
 30. C881 "Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete"
 31. C989 "Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars"
 32. C1059 "Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete"
 33. C1064 "Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete"
 34. C1077 "Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation"
 35. C1116 "Standard Specification for Fiber-Reinforced Concrete and Shotcrete"
 36. C1315 "Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete"
 37. D1751 "Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)"
 38. D1752 "Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction"
 39. D2240 "Standard Test Method for Rubber Property—Durometer Hardness"
 40. D3963 "Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars"
 41. E329 "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction"
 42. E548 "Guide for General Criteria Used for Evaluating Laboratory Competence"
 43. E1643 "Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs"
- D. [American Welding Society \(AWS\)](#) Publications:
1. D1.4 "Structural Welding Code - Reinforcing Steel"
- E. [Concrete Reinforcing Steel Institute \(CRSI\)](#) Publications:
1. [CRSI](#)
 2. "Manual of Standard Practice"
 3. CRSI-WCRSI "Placing Reinforcing Bars"
- F. [National Ready Mixed Concrete Association's \(NRMCA\)](#) Publications:
1. "Certification of Ready Mixed Concrete Production Facilities"
- G. U.S. Department of Commerce (DOC), [National Institute of Standards and Technology \(NIST\)](#) Publications:
1. PS 1 "Construction and Industrial Plywood"

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data for each product specified.
 - 2. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
 - a. Indicate amounts of mix water to be withheld for later addition at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Avoid damaging coatings on steel reinforcement.
 - 2. Repair damaged epoxy coatings on steel reinforcement according to [ASTM D3963](#).

PART 2 PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with [DOC PS 1](#), and as follows:
 - a. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface, or when removed, will leave holes not larger than 1 inch in diameter in concrete surface.
 2. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: [ASTM](#) A615, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: [ASTM](#) A706, deformed.
- C. Steel Bar Mats: [ASTM](#) A184, assembled with clips.
 1. Steel Reinforcement: [ASTM](#) A615, Grade 60, deformed bars.
 2. Steel Reinforcement: [ASTM](#) A706, deformed bars.
- D. Plain-Steel Wire: [ASTM](#) A82, as drawn.
- E. Plain-Steel Wire: [ASTM](#) A82, galvanized.
- F. Deformed-Steel Wire: [ASTM](#) A496.
- G. Plain-Steel Welded Wire Fabric: [ASTM](#) A185, fabricated from as-drawn steel wire into flat sheets.
- H. Deformed-Steel Welded Wire Fabric: [ASTM](#) A497, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to [CRSI](#)'s "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 1. For concrete surfaces exposed to view or weather where legs of wire bar supports contact forms, use [CRSI](#) Class 1 plastic-protected or [CRSI](#) Class 2 stainless-steel bar supports.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- B. Joint Dowel Bars: Plain-steel bars, [ASTM](#) A615, Grade 60. Cut bars true to length with ends square and free of burrs.
- C. Tie Wire: Minimum 16 gage annealed type.

2.4 CONCRETE MATERIALS

- A. Portland Cement: [ASTM](#) C150, Type I.
- B. Portland Cement: [ASTM](#) C150, Type II.
- C. Portland Cement: [ASTM](#) C150, Type III. Permitted only for concrete exposed to weather.
- D. Portland Cement: [ASTM](#) C150, Type V.

1. Fly Ash: [ASTM](#) C618, Class C or F.
 2. Fly Ash: [ASTM](#) C618, Class F.
 3. Ground Granulated Blast-Furnace Slag: [ASTM](#) C989, Grade 100 or 120.
- E. Normal-Weight Aggregate: [ASTM](#) C33, uniformly graded, and as follows:
1. Class: Severe weathering region, but not less than 3S.
 2. Class: Moderate weathering region, but not less than 3M.
 3. Class: Negligible weathering region, but not less than 1N.
 4. Nominal Maximum Aggregate Size: 1-1/2 inches.
 5. Nominal Maximum Aggregate Size: 1 inch.
 6. Nominal Maximum Aggregate Size: 3/4 inch.
- F. Lightweight Aggregate: [ASTM](#) C330.
1. Nominal Maximum Aggregate Size: 1 inch.
 2. Nominal Maximum Aggregate Size: 3/4 inch.
 3. Nominal Maximum Aggregate Size: 1/2 inch.
 4. Nominal Maximum Aggregate Size: 3/8 inch.
- G. Water: Potable and complying with [ASTM](#) C94.

2.5 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Air-Entraining Admixture: [ASTM](#) C260.
- C. Water-Reducing Admixture: [ASTM](#) C494, Type A.
- D. Mid-Range Water-Reducing Admixture: [ASTM](#) C494, Type A.
- E. High-Range, Water-Reducing Admixture: [ASTM](#) C494, Type F.
- F. Water-Reducing and Accelerating Admixture: [ASTM](#) C494, Type E.
- G. Water-Reducing and Retarding Admixture: [ASTM](#) C494, Type D.
- H. 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.

2.6 FIBER REINFORCEMENT

- A. Micro-Synthetic Fiber for plastic shrinkage crack control: : Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete, complying with [ASTM](#) C1116, Type III, 1/2 to 1-1/2 inches long.

2.7 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
1. Profile: Ribbed with center bulb.

2.8 VAPOR RETARDERS

- A. Refer to Section 07 10 00.

2.9 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Material shall become an integral part of concrete surface and leave floor free of residue or film.
 - 2. Absorptive Cover: [AASHTO](#) M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: [ASTM](#) C171, .006 inch (6 mil) thick, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: [ASTM](#) C309, Type 1, Class B.
- E. Clear, Waterborne, Curing and Sealing Compound: [ASTM](#) C1315, 25% solids minimum.

2.10 RELATED MATERIALS

- A. Joint-Filler Strips - Expansion and Isolation Joints: [ASTM](#) D1751, asphalt-saturated cellulosic fiber, or [ASTM](#) D1752, cork or self-expanding cork.
- B. Bonding Agent: [ASTM](#) C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.11 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: [ASTM](#) C150, portland cement or hydraulic or blended hydraulic cement as defined in [ASTM](#) C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to [ASTM](#) C109.
- B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm).
 - 1. Cement Binder: [ASTM](#) C150, portland cement or hydraulic or blended hydraulic cement as defined in [ASTM](#) C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5700 psi at 28 days when tested according to [ASTM C109](#).

2.12 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
 1. Proportion normal-weight concrete according to [ACI 211.1](#) and [ACI 301](#).
 2. Proportion lightweight structural concrete according to [ACI 211.2](#) and [ACI 301](#).
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- C. Proportion concrete mix for each class of concrete to achieve the strengths (28 days) and slumps noted on the drawings.
- D. Cementitious Materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to [ACI 301](#) requirements.
- E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
- F. Maximum Water-Cementitious Materials Ratio: 0.50 for concrete required to have low water permeability.
- G. Maximum Water-Cementitious Materials Ratio: 0.45 for concrete exposed to deicers or subject to freezing and thawing while moist.
- H. Maximum Water-Cementitious Materials Ratio: 0.40 for corrosion protection of steel reinforcement in concrete exposed to chlorides from deicing chemicals, salt, saltwater, brackish water, seawater, or spray from these sources.
- I. Maximum Water-Cementitious Materials Ratio: 0.50 for concrete subject to moderate sulfate exposure.
- J. Maximum Water-Cementitious Materials Ratio: 0.45 for concrete subject to severe or very severe sulfate exposure.
- K. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:
 1. Air Content: 5.5 percent for 1-1/2-inch nominal maximum aggregate size.
 2. Air Content: 6 percent for 1-inch nominal maximum aggregate size.
 3. Air Content: 6 percent for 3/4-inch nominal maximum aggregate size.

- L. Do not air entrain concrete to trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.
- M. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- N. Micro-Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1 lb/cu. yd.
- O. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixes where indicated.

2.13 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to [CRSI](#)'s "Manual of Standard Practice."

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to [ASTM](#) C94 and [ASTM](#) C1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to [ASTM](#) C94. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to [ACI](#) 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of [ACI](#) 117.

- C. Limit concrete surface irregularities, designated by [ACI 347R](#) as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch.
 - 2. Class B, 1/4 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
 - 1. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete unless otherwise noted or detailed on drawings.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor bolts, accurately located, to elevations required.
 - 2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.
- B. Embedded items shall be located so as not to reduce the strength of the construction. They shall be thoroughly clean and free from coating, rust, scale, oil and other foreign material. No wood shall be permanently embedded in concrete.
- C. Embedments shall be maintained in position and protected until the concreting is complete.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
 - 1. At least 70 percent of 28-day design compressive strength.
 - 2. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to [ACI 301](#).
 - 3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by GC's Representative.

3.4 SHORES AND RESHORES

- A. Comply with [ACI 318](#), [ACI 301](#), and recommendations in [ACI 347R](#) for design, installation, and removal of shoring and reshoring.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

- A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Place, protect, and repair vapor-retarder sheets according to [ASTM E1643](#) and manufacturer's written instructions.
- B. Seal overlapping joints in vapor retarders with vapor retarder tape per vapor retarder manufacturer's printed directions.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape of type recommended by vapor retarder manufacturer to create an air-tight seal between penetrating objects and vapor retarder.
- D. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.6 STEEL REINFORCEMENT

- A. General: Comply with [CRSI](#)'s "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to [ASTM D3963](#).
- G. Zinc-Coated Reinforcement: Use galvanized steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Owner's Representative.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: 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.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "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. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
 - 1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Owner's Representative.
- C. Before placing concrete, water may be added at Project site, subject to limitations of [ACI 301](#).
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.
- D. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- E. Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
 - 1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by [ACI 309R](#).
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to

consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: Comply with [ACI 306.1](#) and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- H. Hot-Weather Placement: Place concrete according to recommendations in [ACI 305R](#) and as follows, when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding [ACI 347R](#) limits for class of surface specified.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.
 - 1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

2. Do not apply rubbed finish to smooth-formed finish.
- C. Rubbed Finish: Apply the following to smooth-formed finished concrete:
 1. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in [ACI 302.1R](#) for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.
 1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.
 2. Finish and measure surface so gap at any point between concrete surface and an unlevelled freestanding 10-foot long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed 3/16 inch.
- E. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Owner's Representative before application.
- G. Slip-Resistive Aggregate Finish (where required by local codes): Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
 1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
 2. After broadcasting and tamping, apply float finish.
 3. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose slip-resistive aggregate.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Curbs: Other than specified in Section 32 13 13 Concrete Paving, provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.13 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with [ACI 306.1](#) for cold-weather protection and with recommendations in [ACI 305R](#) for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

- a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid epoxy joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Owner's Representative. Remove and replace concrete that cannot be repaired and patched to Owner's Representative approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. 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 in any dimension in solid concrete but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. 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 will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Owner's Representative.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Owner's Representative's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Owner's Representative's approval.

3.16 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to [ASTM C172](#) shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - 2. Slump: [ASTM C143](#); one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: [ASTM C231](#), pressure method, for normal-weight concrete; [ASTM C173](#), volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 - 4. Concrete Temperature: [ASTM C1064](#); one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 - 5. Unit Weight: [ASTM C567](#), fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 - 6. When frequency of testing will provide fewer than five compressive-strength tests
Compression Test Specimens: [ASTM C31](#); cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
 - a. Cast and field cure one set of four standard cylinder specimens for each composite sample.
 - 7. Compressive-Strength Tests: [ASTM C39](#); test two laboratory-cured specimens at 7 days and two at 28 days.
 - a. Test two field-cured specimens at 7 days and two at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- D. Strength of each concrete mix 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.

- E. Test results shall be reported in writing to Owner's Representative, Owner's Representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.
- F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Owner's Representative but will not be used as sole basis for approval or rejection of concrete.
- G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner's Representative. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with [ASTM](#) C42 or by other methods as directed by Owner's Representative.

END OF SECTION 03 33 00 (03300)

SECTION 03 54 13- GYPSUM CEMENT UNDERLAYMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gypsum Cement Floor Underlayment for Wood Frame Construction

1.2 REFERENCES

A. [ASTM International \(ASTM\)](#) Publications:

1. C472 "Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete"

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Manufacturer Certificates: Signed by manufacturers of both underlayment and floor covering system certifying that products are compatible.

1.4 QUALITY ASSURANCE

- A. Installer's Qualifications: An experienced installer who is acceptable to manufacturer, who has completed cement-based underlayment applications similar in material and extent to that required for this Project, and whose work has resulted in construction with a record of successful in-service performance.

1.5 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, mixing with other components, and application.
- B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written recommendations for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting underlayment performance.
- B. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.

1.7 COORDINATION

- A. Coordinate cement-based underlayment with requirements of finish flooring products, including adhesives, specified in Division 09 Sections.
1. Before installing surface sealers recommended by underlayment manufacturer, if any, verify compatibility with finish flooring installation adhesives.

PART 2 PRODUCTS

2.1 PRODUCTS AND MATERIALS

- A. Gypsum Cement: Gypsum cement product as manufactured by listed manufacturers.
- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4", or coarse sand as recommended by underlayment manufacturer.
 - 1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- C. Water: Potable and at a temperature of not more than 70 degrees F.
- D. Floor Primer and Sealer: Products of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

2.2 MIXES:

- A. Mix proportions and methods shall be in strict accordance with product manufacturer's recommendations.
 - 1. Minimum compressive strength of 3500 psi. Do not over water.

PART 3 PRODUCTS

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of underlayment including substrate moisture content.
- B. Begin underlayment application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare and clean substrate according to manufacturer's written instructions for substrate indicated. Provide clean, dry, neutral-pH substrate for underlayment application.
 - 1. Subfloor shall be structurally sound, clean, and free of mud, oil, grease, or other contaminants.
- B. Prior to installation of Gypsum Cement Underlayment, General Contractor shall inspect the area to be poured for proper attachment of the subfloor and replace any areas of subfloor that have weakened or delaminated during construction. All stud wall base plates in doors and other openings shall be removed.
 - 1. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.
 - 2. Treat nonmoving substrate cracks to prevent cracks from telegraphing through underlayment according to manufacturer's written recommendations.
 - 3. Fill substrate voids to prevent underlayment from leaking.
- C. Priming Subfloor:
 - 1. Spray one coat of Floor Primer with a concrete or garden sprayer over entire plywood deck using mix as recommended by underlayment. When applying underlayment over APA span-rated oriented strand or waferboard, apply conditioner and primer as required by underlayment manufacturer.
- D. Expansion Joints: Allow joints to continue through the underlayment at same width.

3.3 APPLICATION OF GYPSUM CEMENT UNDERLAYMENT

- A. Scheduling: Application shall not begin until the building is enclosed, including roof, windows, doors and other fenestration. Install after drywall installation.
- B. Application: Place underlayment at 3/4" minimum over subfloor. Spread and screed to a smooth surface. Except at authorized joints, place underlayment as continuously as possible until application is complete so that no gypsum cement slurry is placed against underlayment product that has obtained its initial set.
- C. Curing: General Contractor shall provide continuous ventilation and adequate heat to rapidly remove moisture from the area until the underlayment is dry. Contractor shall provide mechanical ventilation if necessary. This Contractor shall test for dryness in the presence of the Owner's Representative utilizing the procedure as recommended by the underlayment manufacturer.

3.4 PREPARATION FOR INSTALLATION OF GLUE DOWN FLOOR GOODS

- A. Sealing: Seal all areas that receive glue according to the underlayment manufacturer's specifications. Any floor areas where the surface has been damaged shall be cleaned and sealed regardless of floor covering to be used. Where floor goods manufacturers require special adhesive or installation systems, their requirements supersede these recommendations.

3.5 FIELD QUALITY CONTROL

- A. Slump Test: Gypsum cement mix shall be tested for slump as it's being pumped using a 2" x 4" cylinder for compliance with manufacturer's written recommendations.
- B. Field Samples: At least one set of 3 molded cube samples shall be taken from each day's pour during the application. Cubes shall be tested as recommended by the underlayment manufacturer in accordance with [ASTM](#) C472 using split brass molds. Test results shall be available to Owner's Representative and Contractor from applicator upon request.

3.6 PROTECTION

- A. During construction, contractor shall place temporary wood planking over underlayment wherever it will be subjected to heavy wheeled or concentrated loads.

END OF SECTION 03 54 13 (03500)

SECTION 04 20 00 - UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Types of masonry work required include:
 - a. Face Brick
 - b. Special Masonry Shapes
 - c. Mortar and Grout Materials
 - d. Joint Reinforcement, Ties and Anchoring Devices
 - e. Reinforcing Steel
 - f. Masonry Accessories

B. Products installed, but not furnished, under this Section include the following:

1. [Shelf Angles](#) for unit masonry, furnished under Section 05 50 00, Metal Fabrications.
2. Hollow-metal frames in unit masonry openings, furnished under Section 08 11 13, Hollow Metal Doors and Frames.

1.2 REFERENCES

A. [ASTM International](#) Publications:

1. A82 "Standard Specification for Steel Wire, Plain, for Concrete Reinforcement"
2. A185 "Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete"
3. A307A307 "Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength"
4. A496 "Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement"
5. A497 "Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete"
6. A615 "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"
7. A951 "Standard Specification for Masonry Joint Reinforcement"
8. C67 "Test Methods of Sampling and Testing Brick and Structural Clay Tile"
9. C90 "Standard Specification for Loadbearing Concrete Masonry Units"
10. C140 "Test Methods of Sampling and Testing Concrete Masonry Units and Related Units"
11. C144 "Standard Specification for Aggregate for Masonry Mortar"
12. C216 "Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)"
13. C270 "Standard Specification for Mortar for Unit Masonry"
14. C404 "Standard Specification for Aggregates for Masonry Grout"

15. C476 "Standard Specification for Grout for Masonry"
 16. C641 "Standard Test Methods for Mastics and Coatings Used With Thermal Insulation"
 17. C1314 "Standard Test Method for Compressive Strength of Masonry Prisms"
 18. D226 "Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing"
 19. D2287 "Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds"
 20. E119 "Standard Test Methods for Fire Tests of Building Construction and Materials"
 21. E514 "Test Method for Water Penetration and Leakage through Masonry"
- B. [American Concrete Institute \(ACI\)](#) / [American Society of Civil Engineers \(ASCE\)](#) Publications:
1. ACI 530.1-92/ASCE 6-92/TMS 602.92, "Specifications for Masonry Structures, with selected ASTM References"
- C. [National Concrete Masonry Association \(NCMA\)](#) Publications:
1. "Tek" Bulletins

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
1. Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements.
 2. Samples for Initial Selection: For the following:
 - a. Unit masonry samples in small-scale form showing the full range of colors and textures available for each different exposed masonry unit required.
 3. Colored mortar Samples showing the full range of colors available.
 4. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.4 QUALITY ASSURANCE

- A. Unit Masonry Standard: Comply with [ACI](#) 530.1/ASCE 6, "Specifications for Masonry Structures", except as otherwise indicated.
1. Revise [ACI](#) 530.1/ASCE 6 to exclude Sections 1.5; Parts 1.6-A.1.b and 1.6-A.1.c; and Part 3.3-E.
- B. Fire Resistance Ratings: Where indicated, provide materials and construction which are identical to those of assemblies with fire-resistance ratings determined by testing in compliance with [ASTM](#) E119 by a recognized testing and inspecting organization, by equivalent concrete masonry thickness, or by another means, as acceptable to authority having jurisdiction.

- C. Single Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each different product required for each continuous surface or visually related surfaces.
- D. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.
- E. Sample Panels: Before installing unit masonry, build sample panels, using materials indicated for the completed Work, to verify selection and to demonstrate aesthetic effects. Build sample panels for each type of exposed unit masonry assembly in sizes approximately [48 inches] long by [48 inches] high by full thickness.
 - 1. Locate panels in the locations indicated or, if not indicated, as directed by [Architect] [Owner's Representative].
 - 2. Clean exposed faces of panels with masonry cleaner indicated.
 - 3. Maintain sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
 - 4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically Accepted by the [Architect] in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels, unless such deviations are specifically Accepted by the [Owner's Representative] in writing.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver masonry materials to project in undamaged condition.
- B. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.
- E. Store masonry accessories, including metal items, to prevent deterioration by corrosion and accumulation of dirt.
- F. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

1.6 PROJECT/SITE CONDITIONS

- A. Protection of Work: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of [\[24 inches\]](#) down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform roof loading for at least 12 hours after building masonry walls or columns.
- C. Do not apply uniform roof or floor loading until the masonry has cured to the extent that it will safely support the intended load, a minimum of 12 hours after building masonry walls or columns.
- D. Do not apply concentrated loads until the masonry has cured to the extent that it will safely support the intended load, a minimum of 3 days after building masonry walls or columns.
- E. Cold and Hot Weather Protection
 1. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold weather construction requirements contained in [ACI 530.1/ASCE 6/TMS 602](#).
 2. Remove masonry damaged by freezing conditions.
 3. Cold Weather Construction: When the ambient temperature is within the limits indicated, use the following procedures:
 - a. 40 to 32 deg F: Heat mixing water or sand to produce mortar temperatures between 40 and 120 deg F.
 - b. 32 to 25 deg F: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F. Heat grout materials to produce grout temperatures between 40 and 120 deg F. Maintain mortar and grout above freezing until used in masonry.
 - c. 25 to 20 deg F: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F. Heat grout materials to produce grout temperatures between 40 and 120 deg F. Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F if grouting. Use heat on both sides of walls under construction.
 - d. 20 deg F and Below: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F. Heat grout materials to produce grout temperatures between 40 and 120 deg F. Maintain mortar and grout above freezing until used in masonry. Heat masonry units to 40 deg F. Provide enclosures and use heat on both sides of walls under construction to maintain temperatures above 32 deg F within the enclosures.
 4. Cold-Weather Protection: When the mean daily temperature is within the limits indicated, provide the following protection:
 - a. 40 to 25 deg F: Cover masonry with a weather-resistant membrane for 48 hours after construction.
 - b. 25 to 20 deg F: Cover masonry with insulating blankets or provide enclosure and heat for 48 hours after construction to prevent freezing. Install wind breaks when wind velocity exceeds 15 mi./h.

- c. 20 deg F and Below: Provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for 48 hours after construction.

PART 2 PRODUCTS

2.1 MASONRY UNITS, GENERAL

1. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
2. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 FACE BRICK:

A. General: Provide shapes indicated and as follows:

1. Provide units without cores or frogs and with exposed surfaces finished for ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces.

B. Face Brick: Facing brick complying with ASTM C 216[or hollow brick complying with ASTM C 652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area)].

1. Products: Subject to compliance with requirements, **[available products that may be incorporated into the Work include, but are not limited to, the following]**:
 - a. Harmar Brownstone Smooth 737FR
2. Grade: [MW or SW].
3. Type: **[FBX]**
4. Initial Rate of Absorption: Less than **30 g/30 sq. in. (30 g/194 sq. cm)** per minute when tested per ASTM C 67.
5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
6. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from **10 feet (3 m)**.
7. Size (Actual Dimensions): **[3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long]**.

2.3 FIRE RATINGS:

- #### A. Where fire ratings on masonry walls are shown on the Drawings, the Contractor shall make certain that the fire-resistant units to be used qualify for the ratings.

2.4 MORTAR AND GROUT MATERIALS

- #### A. Colored Cement Product: Packaged blend made from masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors. Use cement with synthetic iron oxide pigment only.
2. Aggregate for Mortar: [ASTM](#) C144; except for joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - a. Gray-Mortar Aggregates: Natural Type "S" sand or ground white stone.
 - b. Mortar Aggregates: Natural-colored sand.
- B. Aggregate for Grout: [ASTM](#) C404.
- C. Grout for Unit Masonry: Comply with [ASTM](#) C476 for grout for use in construction of reinforced and nonreinforced unit masonry. Use grout of consistency indicated or, if not otherwise indicated, of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout. Minimum compressive strength shall be 2,500 psi in 28 days.
 1. Use fine grout in grout spaces less than 2" in horizontal direction, unless otherwise indicated.
 2. Use coarse grout (maximum 3/8" aggregate) in grout spaces 2" or more in least horizontal dimension, unless otherwise indicated.
- D. Integral Water Repellent Mortar Admixture:
- E. Water: Potable

2.5 JOINT REINFORCEMENT, TIES AND ANCHORING DEVICES

- A. General: Comply with [ASTM](#) A951.
- B. Materials: Comply with requirements indicated below for basic materials and with requirements indicated under each form of joint reinforcement, tie and anchor for size and other characteristics:
 1. Zinc-Coated (galvanized) Steel Wire: [ASTM](#) A82 for uncoated wire and with [ASTM](#) C641 for zinc coating of class indicated below:
 - a. Class 1 (0.40 oz. per sq. ft. of wire surface).
- C. Joint Reinforcement: Provide welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10', with prefabricated corner and tee units, and complying with requirements indicated below:
 1. Width: Fabricate joint reinforcement in units with widths of approximately 2" less than nominal width of walls and partitions as required to provide mortar coverage of not less than 5/8" on joint faces exposed to exterior.
 2. Wire Size for Side and Cross Rods: #9 Gauge
 3. For single-wythe masonry, provide type as follows with single pair of side rods:
 - a. Truss design with continuous diagonal cross rods spaced not more than 16" o.c.
 4. For multi-wythe masonry with cavity filled solid with mortar, provide type as follows:
 - a. Truss design with diagonal cross rods spaced not more than 16" o.c. and number of side rods as follows:

- D. Flexible Anchors: Where flexible anchors are indicated for connecting masonry to structural framework, provide 2-piece anchors, as described below, which permit vertical or horizontal differential movement between wall and framework parallel to, but resist tension and compression forces perpendicular to, plane of wall.
 - 1. Masonry Veneer Anchors: Two-piece assemblies which permit vertical or horizontal differential movement between wall and framework parallel to, but resist tension and compression forces perpendicular to, plane of wall, consisting of wire tie section and metal anchor section for attachment over sheathing to metal studs and complying with the following requirements:
 - a. Wire Size: 0.1875" Diameter
 - b. Wire Tie Shape: Rectangular with Cavity Drip
 - c. Wire Tie Length: As Required to Extend Within 1-1/2" of Masonry Wythe of Veneer Face
 - 2. Control Joint Anchors: Corrugated galvanized steel, 6-1/4" long x 1" wide x 24 gauge, with 1/4" wide x 1-3/4" deep V-groove.
- E. Anchor Section: Sheet metal plate, with screw holes top and bottom and with raised, rib-stiffened strap stamped into center to provide slot between strap and plate for connection of wire tie, of overall size and thickness indicated below:
 - 1. Size: Plate and strap size: 1-1/4" wide for plate, 5/8" for strap x lengths indicated below. Slot clearance formed between face of plate and back of strap at maximum rib projection: 1/32" + diameter of wire tie.
 - 2. Plate and Strap Lengths: 5" and 3-5/8", with both sides of plate stiffened by ribs.
 - 3. Thickness: 0.0747" (14 Gauge)

2.6 REINFORCING STEEL

- A. General: Provide reinforcing steel complying with requirements of referenced unit masonry standard and this article.
- B. Steel Reinforcing Bars: Material and grade as follows:
 - 1. Billet steel complying with [ASTM](#) A615, Grade 60.
- C. Deformed Reinforcing Wire: [ASTM](#) A496.
- D. Plain Welded Wire Fabric: [ASTM](#) A185.
- E. Deformed Welded Wire Fabric: [ASTM](#) A497.

2.7 MASONRY ACCESSORIES

- A. Premolded Control Joint Strips: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall. Size and configuration as indicated.
 - 1. Polyvinyl Chloride Complying with [ASTM](#) D2287, General Purpose Grade, Designation PVC-63506.
- B. Bond Breaker Strips: Asphalt-Saturated Organic Roofing Felt Complying with [ASTM](#) D226, Type I (No. 15 Asphalt Felt)
- C. Weepholes: Provide the following for weepholes:

1. Round Plastic Weep/Vent Tubing: Medium Density Polyethylene with Rope Insert, Outside Diameter and Length as Indicated Below:

- a. 3/8" o.d. x 4" long

D. Flexible Flashing

1. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
 - 1) Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025-inch-thick, with a 0.015 inch thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.
 - 2) Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
2. Application: Unless otherwise indicated, use the following:
 - a. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing termination drip plates.

- E. Anchor Bolts: Provide steel bolts with hex nuts and flat washers complying with [ASTM](#) A307, Grade A, hot-dip galvanized to comply with [ASTM](#) C153, Class C, in sizes and configuration indicated.

2.8 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard strength general purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces of type indicated; composed of blended organic and inorganic acids combined with special wetting systems and inhibitors; expressly Accepted for intended use by manufacturer of masonry units being cleaned without damaging or discoloring masonry surfaces.
- B. Accepted Manufacturers:

2.9 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds or other admixtures, unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
 2. Add cold-weather admixture (if used) at the same rate for all mortar, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Mixing: Combine and thoroughly mix cementitious, water and aggregates in a mechanical batch mixer; comply with referenced [ASTM](#) standards for mixing time and water content.
- C. Mortar for Unit Masonry: Comply with [ASTM](#) C270, Proportion Specification, for types of mortar required, unless otherwise indicated.
1. Use Type mortar as shown on Drawings.
 - a. Minimum compressive strength as shown on Drawings.]
 2. For masonry below grade, in contact with earth, and where indicated, use Type – S.
 3. For reinforced masonry and where indicated, use Type – S

4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type - S.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 1. Verify that foundations are within tolerances specified.
 2. Verify that reinforcing dowels are properly placed.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 INSTALLATION - GENERAL

- A. Do not wet concrete masonry units.
- B. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.
- C. Thickness: Build cavity and composite walls, floors and other masonry construction to the full thickness shown. Build single-wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness indicated.
- D. Build chases and recesses to accommodate items specified in this Section or in other sections of the Specifications as shown or required. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.
- E. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.
- F. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use full-size units without cutting where possible.
 1. Use dry cutting saws to cut concrete masonry units.
- G. Select and arrange units for exposed unit masonry to provide a uniform blend of colors and textures.
- H. Construction Tolerances
 1. Comply with tolerances in [ACI 530-1/ASCE 6/TMS 602](#) and the following:
 - a. Variation from Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10', or 3/8" in a story height not to exceed 20'. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more. For vertical alignment of head joints, do not exceed plus or minus 1/4" in 10'.
 - b. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4" in any bay or 20'

maximum, nor 1/2" in 40' or more. For top surface of bearing walls, do not exceed 1/8" between adjacent floor elements in 10' or 1/16" within width of a single unit.

- c. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.
- d. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

3.3 INSTALLATION - MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.
- B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.
- C. Bond Pattern: Lay exposed masonry in the bond pattern shown or, if not shown, lay in [\[running\]](#) [\[stacked\]](#) bond with vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2". Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: In each course, rack back 1/2-unit length for 1/2-running bond or 1/3-unit length for 1/3 running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.
- E. Built-in Work: As construction progresses, build-in items specified under this and other Sections of these Specifications. Fill in solidly with masonry around built-in items.
 - 1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
 - 2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
 - 3. Fill cores in hollow concrete masonry units with grout 24" under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.
- F. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. At fire-rated partitions, install firestopping in joint between top of partition and underside of structure above to comply with Division 7 Section "Firestopping."

3.4 INSTALLATION - MORTAR BEDDING AND JOINTING

- A. Lay solid masonry units and brick units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

1. At cavity walls, bevel beds away from cavity, to minimize mortar protrusions into cavity. As work progresses, trowel mortar fins protruding into cavity flat against the cavity face of the brick.
- B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.
- C. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.
- D. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise indicated.
- E. All exposed joints shall be well-tooled to a concave or rodded profile, unless otherwise indicated.
 1. Provide raked joints at all vertical scores in scored brick units. Strike to match concave or rodded profile of horizontal joints.
 2. Rake-out expansion joints and joints indicated on Drawings to receive sealant.
- F. Mortar joints shall be struck at a consistent time interval when mortar is at the same medium stiff consistency in order to minimize color variations.
- G. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.
- H. Collar Joints: After each course is laid, fill the vertical longitudinal joint between wythes solidly and with mortar for the following masonry work:
 1. All exterior walls, except cavity walls, and interior walls and partitions.
- I. Use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes. Install at not more than 16" o.c. vertically.
- J. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.
- K. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:
 1. Provide individual metal ties at not more than 24" o.c. vertically.
- L. Provide weep holes in exterior wythe of cavity wall located immediately above ledges and flashing, spaced 2'-0" o.c., unless otherwise indicated.

3.5 INSTALLATION - CAVITIES

- A. Keep cavities clean of mortar droppings and other materials during construction.
 1. Install Cavity Drainage Material in cavities in accordance with manufacturer's recommendations.
 2. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.

3.6 INSTALLATION - MASONRY JOINT REINFORCEMENT

- A. General: Provide continuous masonry joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls. Lap reinforcing a minimum of 6".
- B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Reinforce walls with continuous horizontal joint reinforcing, unless specifically noted to be omitted.
- D. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
- E. Space continuous horizontal reinforcement as follows:
 - 1. For multi-wythe walls (solid or cavity) which are structurally bonded by masonry headers or individual wire ties, space horizontal reinforcement 24" o.c. vertically.
 - 2. For single-wythe walls, space reinforcement at 16" o.c. vertically, unless otherwise indicated.
 - 3. For parapets, space reinforcement at 8" o.c. vertically, unless otherwise indicated.
- F. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcement placed in 2 horizontal joints approximately 8" apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'-0" beyond jambs of the opening, except at control joints.
 - 1. In addition to wall reinforcement, provide additional reinforcement at openings as required to comply with the above.

3.7 ANCHORING MASONRY WORK

- A. General: Provide anchor devices of type indicated.
- B. Anchor single wythe masonry veneer to metal studs with masonry veneer anchors to comply with the following requirements:
 - 1. Fasten each anchor section through sheathing to metal studs with two metal fasteners of type indicated.
 - 2. Embed tie section in masonry joints. Provide not less than 1" air space between back of masonry veneer wythe and face of sheathing.
 - 3. Locate anchor section relative to course in which tie section is embedded to allow maximum vertical differential movement of tie up and down.
 - 4. Space anchors as indicated, but not more than 16" o.c. vertically and 24" o.c. horizontally. Install additional anchors within 1'-0" of openings and at intervals around perimeter not exceeding 3'-0".
- C. Anchor masonry veneers to concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten anchors to concrete and masonry backup with metal fasteners of type indicated.
 - 2. Embed connector sections and continuous wire in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.

3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and [32 inches] [24 inches] o.c. horizontally with not less than 1 anchor for each [3.5 sq. ft.] [2.67 sq. ft.] of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

3.8 INSTALLATION - FLASHING

- A. General: Provide concealed flashing in masonry work at, or above, shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior. Prepare masonry surfaces smooth and free from projections which could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar. Extend flashings through exterior face of masonry and turn down to form drip.
 1. Refer to Division 07 Specification Sections for flashing materials.
- B. Extend flashing the full length of lintels and shelf angles and minimum of 4" into masonry each end. Extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4", and through the inner wythe to within 1/2" of the interior face of the wall in exposed work. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2". At heads and sills, turn up ends not less than 2" to form a pan. Install metal drip plates in location as recommended by flashing manufacturer. Extend metal drip plates on exterior to 1/4 inch past wall surface.
- C. Install flashing to comply with manufacturer's instructions.
- D. Install weep holes in the exterior widths of the head joints of the first course of masonry immediately above embedded flashings. Space 24" o.c., unless otherwise indicated.

3.9 INSTALLATION - LINTELS

- A. Provide masonry lintels where shown and wherever openings of more than 2'-0" for block size units or more than 1'-0" for brick size units are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels.
- B. Provide minimum bearing of 8" at each jamb, unless otherwise indicated.

3.10 INSTALLATION - CONTROL AND EXPANSION JOINTS

- A. General: Provide vertical and horizontal expansion, control and isolation joints in masonry where shown. Build-in related items as the masonry work progresses.
- B. is not shown, place vertical joints spaced not to exceed 30'-0" o.c. for concrete masonry wythes if reinforced, or 20'-0" o.c. if not reinforced. Locate control joints at points of natural weakness in the masonry work.
- C. Build-in non-metallic joint fillers where indicated.

3.11 REPAIRING, POINTING AND CLEANING

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Install new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

- B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings and adjacent work to provide a neat, uniform appearance, prepared for application of sealants.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel. Leave 1/2 panel uncleaned for comparison purposes. Obtain [\[Architect's\]](#) approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film or waterproof masking tape.
 - 4. Clean concrete unit masonry to comply with masonry manufacturer's directions and applicable [NCMA](#) "Tek" bulletins.

3.12 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to Installer, which ensures unit masonry work being without damage and deterioration at time of substantial completion.

END OF SECTION 04 20 00 (04200)

SECTION 04 20 10 – MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Mortar and grout for masonry.

1.2 SUBMITTALS

- A. Samples: Submit two samples of mortar, illustrating mortar color and color range.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 530 and ACI 530.1.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
- B. Hot Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Hot Weather Masonry Construction.

PART 2 PRODUCTS

1.5 MATERIALS

- A. Portland Cement: ASTM C150, Type I, color as selected by Architect.
- B. Mortar Aggregate: ASTM C144, standard masonry type.
- C. Hydrated Lime: ASTM C207.
- D. Mortar Color: Color as selected by Architect.
- E. Grout Aggregate: ASTM C404.
- F. Water: Clean and potable.
- G. Provide dry brick and dry block additive by Grace Company to mortar.
- H. Bonding Agent: Epoxy type.

1.6 MORTAR MIXES

- A. Mortar: ASTM C270, Use 'S' for block above grade and Type 'N' for brick and Type 'M' for block below grade.

1.7 MORTAR MIXING

- A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270.
- B. Add mortar color in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.

1.8 GROUT MIXES

- A. Bond Beams & Engineered Masonry - 3,000 psi strength at 28 days; 8-10 inch slump mixed in accordance with ASTM C94.

1.9 GROUT MIXING

- A. Thoroughly mix grout in quantities needed for immediate use and in accordance with ASTM C94.
- B. Do not use anti-freeze compounds to lower the freezing point of grout.

1.10 MIX TESTS

- A. Testing of Mortar Mix: In accordance with ASTM C780.
- B. Testing of Grout Mix: In accordance with ASTM C1019.

PART 3 EXECUTION

1.11 INSTALLATION

- A. Install mortar in accordance with ASTM C780. Install grout in accordance with manufacturer's instructions.
- B. Work grout into masonry cores and cavities to eliminate voids. Do not displace reinforcement while placing grout. Remove excess mortar from grout spaces.
- C. Do not install grout in lifts greater than 16 inches, two CMU courses without Consolidating grout by rodding.

END OF SECTION 042010

SECTION 05 12 00 - STRUCTURAL STEEL 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. This Section includes the following:
 - 1. Structural steel.
 - 2. Grout.
- B. Related Sections include the following:
 - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 09 painting Sections for surface preparation and priming requirements.

1.3 DEFINITIONS

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

1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC's "Manual of Steel Construction, Allowable Stress Design," Part 4.
 - 2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 5. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed prepared by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Qualification Data: For Installer, fabricator, testing agency.
- E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
1. Structural steel including chemical and physical properties.
 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 3. Direct-tension indicators.
 4. Tension-control, high-strength bolt-nut-washer assemblies.
 5. Shear stud connectors.
 6. Shop primers.
 7. Nonshrink grout.
- F. Source quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- D. Comply with applicable provisions of the following specifications and documents:
1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
 3. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992.
- B. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing
- C. Channels: ASTM A 572/A 572M, Grade 50.
- D. Plate, Bar and Angles: ASTM A 36.
- E. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.
 - a. Finish: Plain.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain.

C. Headed Anchor Rods: ASTM F 1554, Grade 55, weldable, straight.

1. Nuts: ASTM A 563 hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 hardened carbon steel.
4. Finish: Plain.

D. Threaded Rods: ASTM A 193/A 193M, Grade 7.

1. Nuts: ASTM A 563 hex carbon steel.
2. Washers: ASTM F 436 hardened carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Finish: Plain.

2.3 PRIMER

- A. Primer: SSPC-Paint 25, Type I, iron oxide, zinc oxide, raw linseed oil, and alkyd.
- B. Prepare all steel to be compatible with finishes scheduled.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
1. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 2. Mark and match-mark materials for field assembly.
 3. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning, SSPC-SP 2, "Hand Tool Cleaning, SSPC-SP 3, "Power Tool Cleaning."
- F. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened unless noted as Slip critical.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning" when applicable.
 - 2. SSPC-SP 3, "Power Tool Cleaning" when applicable.
 - 3. As required for painting system required.
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not

less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

2.8 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 3. Ultrasonic Inspection: ASTM E 164.
 4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
 1. Bend tests will be performed if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
 2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection.
- H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

- I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened unless noted as Slip critical.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.

2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories and abutting structural steel.
1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- B. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION 051200

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dumpster Gate
2. Loose Bearing and Leveling Plates
3. Loose Steel Lintels
4. Pipe Bollards
5. Miscellaneous Metal Trim
6. Steel Framing and Supports for Applications where framing and supports are not specified in other Sections

1.2 REFERENCES

A. [ASTM International](#) Publications:

1. A27 "Standard Specification for Steel Castings, Carbon, for General Application"
2. A36 "Standard Specification for Carbon Structural Steel".
3. A47 "Standard Specification for Ferritic Malleable Iron Castings"
4. A48 "Standard Specification for Gray Iron Castings"
5. A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"
6. A123 "Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products"
7. A153 "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"
8. A307 "Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength"
9. A563 "Standard Specification for Carbon and Alloy Steel Nuts"
10. A615 "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"
11. A780 "Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings"
12. B633 "Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel"
13. C1107 "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)"
14. E488 "Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements"
15. F593 "Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs"
16. F594 "Standard Specification for Stainless Steel Nuts"

17. F1554 "Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength"

B. [Federal Specifications \(FS\)](#) Publications:

1. [FS](#) B 588 "Bolt, Toggle: And Expansion Sleeve, Screw" (Cancelled)
2. [FS](#) FF S 325
3. [FS](#) FF BS75
4. [FS](#) TT P664 - Paint 25 (supersedes FS TT-P-664), Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel"
5. DOD-P-21035A (formerly MIL-P-21035), Galvanizing Repair Specification

C. [The American Society of Mechanical Engineers \(ASME\)](#) Publications:

1. A17.1 "Handbook on Safety Code for Elevators and Escalators"
2. B18.2.1 "Square and Hex Bolts and Screws, Inch Series"
3. B18.6.1 "Wood Screws (Inch Series)"
4. B18.6.3 "Machine Screws and Machine Screw Nuts"
5. B18.21.1 "Lock Washers (Inch Series)"
6. B18.22.1 "Plain Washers"

D. [National Association of Architectural Metal Manufacturers \(NAAMM\)](#) Publications:

1. "Metal Finishes Manual"
2. "Metal Stairs Manual"

E. [The Society for Protective Coatings \(SSPC\)](#) Publications:

1. [SP - Surface Preparation Standards and Specifications](#)
 - a. SP 3 "Power Tool Cleaning"
2. [PA - Paint Application Standards, Guides, and Specifications](#)
 - a. PA 1 "Shop, Field, and Maintenance Painting of Steel"
3. [Paint - Paint and Coating Standards and Specifications](#)
 - a. Paint 12, Cold-Applied Asphalt Mastic (Extra Thick Film)
 - b. Paint 20 "Zinc-Rich Coating, Type I - Inorganic and Type II - Organic"
 - c. Paint 25 (superceeds FS TT-P-664), Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel"

1.3 SYSTEM DESCRIPTION

A. System Performance Requirements:

1. All stairways, platforms, treads, and landings of Steel Stairs: Capable of supporting a live load of [\[100 lbf\]](#) per sf and a concentrated load of [\[300 lbf\]](#).
2. Handrails (stair): Capable of withstanding a load of 200 lbs. applied in any direction at any point on the rail.
3. Ladders: Comply with [ANSI](#) A14.3.

1.4 SUBMITTALS

- A. General: Submit in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Provide product data for products used in miscellaneous metal fabrications, including paint products and grout.
- C. Submit shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.
- D. Submit samples representative of materials and finished products as may be requested by [\[Architect\]](#).
- E. Welding Certificates: Copies of certificates for welding procedures and personnel.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.
- B. Installer Qualifications: Arrange for installation of metal fabrications specified in this Section by same firm that fabricated them.
- C. Quality welding processes and welding operators in accordance with the following:
 - 1. [AWS](#) D1.1 "Structural Welding Code - Steel"
 - 2. [AWS](#) D1.3 "Structural Welding Code - Sheet Steel"
 - 3. [AWS](#) D1.2 "Structural Welding Code - Aluminum"
- D. Certify that each welder has satisfactorily passed [AWS](#) qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.6 PROJECT/SITE CONDITIONS

- A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

1.7 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 FERROUS METALS

- A. Metal Surfaces, General: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.

- B. Steel Plates, Shapes, and Bars: [ASTM](#) A36
- C. Steel Tubing: Cold-formed steel tubing complying with [ASTM](#) A500.
- D. Steel Pipe: [ASTM](#) A53
 - 1. Black finish, unless otherwise indicated.
 - 2. Galvanized finish for exterior installations, unless shown to receive special coatings.
 - 3. Type E, OR S, Grade B, $F_y = 35$ KSI, unless otherwise indicated, or another weight, type, and grade required by structural loads.
- E. Gray Iron Castings: [ASTM](#) A48, Class 30
- F. Malleable Iron Castings: [ASTM](#) A47, Grade 32510
- G. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.
- H. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, [ASTM](#) A47, or cast steel, [ASTM](#) A27. Provide bolts, washers, and shims as required, hot-dip galvanized per [ASTM](#) A153.
- I. Welding Rods: Select in accordance with [AWS](#) Specifications for the metal alloy to be welded.

2.2 FASTENERS

- A. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required for each application and complying with applicable standards.
 - 1. Bolts and Nuts: Regular hexagon head bolts, [ASTM](#) A307, Grade A with hex nuts [ASTM](#) A563; and, where indicated, flat washers.
 - 2. Anchor Bolts: [ASTM](#) F1554, Grade 30
 - 3. Lag Bolts: Square head type, [ASME](#) B18.2.1
 - 4. Machine Screws: Cadmium plated steel, [ASME](#) B18.6.3
 - 5. Wood Screws: Flat head carbon steel, [ASME](#) B18.6.1
 - 6. Plain Washers: Round, carbon steel, [ASME](#) B18.22.1
 - 7. Lock Washers: Helical, spring type, carbon steel, [ASME](#) B18.21.1
 - 8. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per [ASTM](#) E488, conducted by a qualified independent testing agency.
 - a. Interior Use - Material: Carbon-steel components zinc-plated to comply with [ASTM](#) B633, Class Fe/Zn 5.
 - b. Exterior and Swimming Pool Use - Material: Alloy Group 1 or 2 stainless-steel bolts complying with [ASTM](#) F593 and nuts complying with [ASTM](#) F594.
 - 9. Toggle Bolts: [FS](#) FF-B-588, tumble-wing type, class and style as needed.

2.3 GROUT AND ANCHORING CEMENT

- A. Nonshrink Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with [ASTM](#) C1107. Provide grout specifically recommended by manufacturer for interior and exterior heavy-duty loading applications of type specified in this Section.
- B. Interior Anchoring Cement: Factory-prepackaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Use for interior applications only.
- C. Erosion-Resistant Anchoring Cement: Factory-prepackaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without need for protection by a sealer or waterproof coating and is recommended for exterior use by manufacturer.

2.4 CONCRETE FILL AND REINFORCING MATERIALS

- A. Concrete Materials and Properties: Comply with requirements of Section 03 30 00, and as shown on Drawings, with minimum 28-day compressive strength of 3,000 PSI, unless otherwise indicated.
- B. Non-slip Aggregate Finish: Factory-graded, packaged material containing fused aluminum oxide grits or crushed emery as abrasive aggregate; rustproof and non-glazing; unaffected by freezing, moisture, or cleaning materials.
- C. Reinforcing Bars: [ASTM](#) A615, Grade 60, unless noted otherwise.

2.5 PAINT

- A. Shop Primer for Ferrous Metal: Manufacturer's or fabricator's standard, fast-curing, lead and chromate-free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure complying with performance requirements of [FS](#) TT-P-664.
- B. Galvanizing Repair Paint: High zinc dust content paint for reglazing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or [SSPC](#) Paint 20.
- C. Zinc Chromate Primer: [FS](#) TT-P-645.

2.6 FABRICATION - GENERAL

- A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.
- B. Allow for thermal movement resulting from the following maximum change (range) of exterior metalwork in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss. Temperature Change (Range): [\[120\]](#) Degrees F., ambient; [\[130\]](#) degrees F., material surfaces.

- C. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flathead (countersunk) screws or bolts. Locate joints where least conspicuous.
- D. Weld corners and seams continuously to comply with [AWS](#) recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- F. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.7 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

2.8 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

2.9 LOOSE STEEL LINTELS

- A. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.
- B. Hot-dipped galvanize loose steel lintels located in exterior walls.
- C. Size loose lintels for equal bearing of one inch per foot of clear span but not less than 8 inches bearing at each side of openings, if not indicated on Drawings.

2.10 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports for applications indicated or which are not a part of structural steel framework, as required to complete work.
- B. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed. Spacing of anchors shall not be more than 24" o.c.

2.11 PIPE BOLLARDS

- A. [ASTM](#) A153 galvanized schedule 40 steel pipe with concrete fill, as detailed on Drawings. Provide smooth radius for concrete top to prevent accumulation of rainwater. Provide field painted finish.

2.12 TRASH ENCLOSURE GATE

2.13 MISCELLANEOUS STEEL TRIM

- A. Provide shapes and sizes indicated for profiles shown. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages as required for coordination of assembly and installation with other work.
 - 1. Galvanize miscellaneous framing and supports in exterior locations and where shown to be painted.

2.14 FINISHES, GENERAL

- A. Comply with [NAAMM](#) "Metal Finishes Manual" for "Architectural and Metal Products" for recommendations relative to application and designations of finishes. Finish metal fabrications after assembly.

2.15 STEEL AND IRON FINISHES

- A. Galvanizing: For those items indicated for galvanizing, apply zinc-coating by the hot-dip process in compliance with the following requirements:
 - 1. [ASTM](#) A153 for galvanizing iron and steel hardware.
 - 2. [ASTM](#) A123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch thick and heavier.
- B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for [SSPC](#) surface preparation specifications and environmental exposure conditions of installed metal fabrications: Interiors ([SSPC](#) Zone 1A): [SSPC](#) SP 3 "Power Tool Cleaning".
- C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of [SSPC](#) PA 1 "Paint Application Specification No. 1" for shop painting. Stripe paint all edges, corners, crevices, bolts, welds, and sharp edges.

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

3.2 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with [AWS](#) Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correctly welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on shop drawings, if any.
- B. Anchor supports securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated at girders supported on concrete or masonry, install as specified above for setting and grouting bearing and leveling plates.

3.4 SETTING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set leveling and bearing plates on wedges, shims, or leveling nuts. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
 - 1. Use nonmetallic nonshrink grout, unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 INSTALLING PIPE BOLLARDS

- A. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. After bollards have been inserted into sleeves, fill annular space between bollard and sleeve solidly with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8" toward bollard.
- B. Paint bollards yellow in front of dumpsters.

3.6 TOUCH-UP PAINTING:

- A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with [SSPC](#) PA 1 requirements for touch-up of field painted surfaces.
- B. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- C. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with [ASTM](#) A780.

END OF SECTION 05 55 00 (05500)

SECTION 06 10 00 – ROUGH CARPENTRY

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Framing with the following:
 - a. Dimension Lumber
 - b. Engineered Wood Products
 - 1) Laminated Veneer Lumber (LVL)
 - c. Wood-Based Structural-Use Panels
 - 1) Subflooring
 - 2) Underlayment
 - 3) Wall Sheathing
 - 4) Roof Sheathing
 - 5) Backing Panels
 - d. Wood-Preservative Treated Materials
 - e. Fire-Retardant-Treated Materials
 - f. Wall Sheathings
 - 1) Gypsum Wall Sheathing
 - 2) Fiberboard Wall Sheathing
 - 3) Extruded-Polystyrene-Foam Wall Sheathings
 - 2. Fasteners
 - 3. Metal Framing Anchors
 - 4. Wood Furring, Grounds, Nailers, and Blocking

1.2 REFERENCES

- A. [American Wood-Protection Association \(AWPA\)](#) Publications:
 - 1. C2 "Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes"
 - 2. C9 "Plywood - Preservative Treatment by Pressure Process Document Number"
 - 3. M4 "Standard for the Care of Preservative-Treated Wood Products Document Number"
- B. [ASTM International](#) Publications:
 - 1. A153 "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"
 - 2. A307 "Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength"
 - 3. A563 "Standard Specification for Carbon and Alloy Steel Nuts"
 - 4. A653 "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process"

5. B117 "Standard Practice for Operating Salt Spray (Fog) Apparatus"
6. C27 "Standard Classification of Fireclay and High-Alumina Refractory Brick"
7. C208 "Standard Specification for Cellulosic Fiber Insulating Board"
8. C578 "Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation"
9. C846 "Standard Practice for Application of Cellulosic Fiber Insulating Board for Wall Sheathing"
10. C954 "Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness"
11. C1177 "Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing"
12. D2559 "Standard Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions"
13. D2898 "Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing"
14. D5055 "Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists"
15. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"
16. E699 "Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components"
17. F1667 "Standard Specification for Driven Fasteners: Nails, Spikes, and Staples"

C. [The Engineered Wood Association \(APA\)](#) Publications:

1. Form No. E30, "APA Engineered Wood Construction Guide"

1.3 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- C. Exposed Framing: Dimension lumber not concealed by other construction and indicated to receive a stained or natural finish.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Product Data: For the following products:
 1. Engineered wood products
 2. Underlayment
 3. Insulating sheathing
 4. Metal framing anchors
 5. Construction adhesives

- C. Material certificates for dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee's ([ALSC](#)) Board of Review.
- D. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:
 - 1. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
 - 2. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to Project site.
 - 3. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials.
- E. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.
- F. Warranty of chemical treatment manufacturer for each type of treatment.
- G. Shop Drawings: For Engineered Wood Framing Systems provide layout drawings indicating materials, member sizes, member spacing and accessories required for proper installation. Drawings shall clearly reference construction details, loading assumptions (including location of loads transferred from other levels), and minimum live load and total load deflection criteria.
 - 1. Where installed products are indicated to comply with certain design loadings, include structural computations, materials properties, and other information needed for structural analysis that has been signed and sealed by a qualified professional engineer responsible for their preparation.
- H. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence the following products' compliance with building code in effect for Project.
 - 1. Engineered wood products
 - 2. Metal framing anchors
 - 3. Power-driven fasteners
 - 4. Fire-retardant-treated wood
 - a. National Evaluation Service, Inc.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: To qualify for approval, an independent testing agency must demonstrate to Owner's Representative satisfaction, based on evaluation of agency-submitted criteria conforming to [ASTM](#) E699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- B. Single-Source Responsibility for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product from one source and by a single producer.

- C. Single-Source Responsibility for Engineered Wood Products: Obtain each type of engineered wood product from one source and by a single manufacturer.
- D. Engineering Responsibility: Engineered Wood Framing Systems shall be engineered by qualified professional engineer legally authorized to practice in jurisdiction where Project is located.
- E. Product Identification: All Engineered Wood Products System members shall be clearly marked with manufacturer's name, product series, plant identification, date of manufacture, and code compliance.
- F. Installation Review: The Engineered Wood Products System Manufacturer's Technical Representative shall be available to meet with the Contractors to review installation details prior to the beginning of framing. The Contractor shall give notification to the Technical Representative prior to enclosing the framing to provide opportunity for review of the installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.
 - 1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.
 - 2. Store Engineered Wood materials on dry surfaces supported on raised wood sticks located every 10 feet. Store TJI joists in an upright position.

PART 2 PRODUCTS

2.1 LUMBER, GENERAL

- A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by [ALSC](#)'s Board of Review.
- B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
 - 1. Northeastern Lumber Manufacturers Association ([NELMA](#))
 - 2. National Lumber Grades Authority (Canadian) ([NLGA](#))
 - 3. Southern Pine Inspection Bureau ([SPIB](#))
 - 4. West Coast Lumber Inspection Bureau ([WCLIB](#))
 - 5. Western Wood Products Association ([WWPA](#))
- C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
 - 1. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps and provide grade-compliance certificates issued by inspection agency.
- D. 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.

1. Provide dressed lumber, S4S, unless otherwise indicated.
2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
3. Provide lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

2.2 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the [ALSC](#) National Grading Rule (NGR) provisions of the inspection agency indicated.
- B. Moisture Content: 15 percent maximum for lumber items not specified to receive wood preservative treatment.
- C. Non-Load-Bearing Interior Partitions: Provide framing of the following grade and species:
 1. Grade: Construction.
 2. Species: Any species with a modulus of elasticity and an extreme fiber stress in bending as indicated on Drawings
 - a. Exception: Southern (yellow) pine is not permitted.
- D. Exterior and Load-Bearing Walls: Provide framing of the following grade and species:
 1. Grade: No. 2.
 2. Species: Any species with a modulus of elasticity and an extreme fiber stress in bending as indicated on Drawings
 - a. Exception: Southern (yellow) pine is not permitted.
- E. Ceilings (Non-Load-Bearing): For ceiling framing that does not support a floor, roof, or attic, provide the following grade and species:
 1. Grade: Construction or No. 2.
 2. Species: Any species with a modulus of elasticity and an extreme fiber stress in bending as indicated on Drawings
 - a. Exception: Southern (yellow) pine is not permitted.
- F. Other Framing Not Listed Above: Provide the following grades and species:
 1. Grade: No. 1.
 2. Species: Any species with a modulus of elasticity and an extreme fiber stress in bending as indicated on Drawings
 - a. Exception: Southern (yellow) pine is not permitted.
- G. Exposed Framing: Provide material hand-selected from lumber of species and grade indicated below for uniformity of appearance and freedom from characteristics that would impair finish appearance.
 1. Species and Grade: As indicated above for load-bearing construction of same type.

2.3 BOARDS

- A. Concealed Boards: Where boards will be concealed by other work, provide lumber with 15 percent maximum moisture content and of following species and grade:

1. Species and Grade: Eastern softwoods, No. 3 Common per [NELMA](#) rules.
2. Species and Grade: Northern species, No. 3 Common or Standard per [NLGA](#) rules.
3. Species and Grade: Mixed southern pine, No. 2 per [SPIB](#) rules.
4. Species and Grade: Hem-fir, Standard per [WCLIB](#) rules or No. 3 Common per [WWPA](#) rules.
5. Species and Grade: Spruce-pine-fir, Standard per [WCLIB](#) rules or No. 3 Common per [WWPA](#) rules.
6. Species and Grade: Western woods, Standard per [WCLIB](#) rules or No. 3 Common per [WWPA](#) rules.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
- C. Moisture Content: 15 percent maximum for lumber items not specified to receive wood preservative treatment.
- D. Grade:
 1. For dimension lumber sizes, provide No. 3 or Standard grade lumber per [ALSC](#)'s NGRs of any species.
 2. For board-size lumber, provide one of the following:
 - a. No. 3 Common grade per [NELMA](#), [NLGA](#), or [WWPA](#);
 - b. No. 2 grade per [SPIB](#)
 - c. Standard grade per [NLGA](#), [WCLIB](#) or [WWPA](#) of any species.

2.5 ENGINEERED WOOD PRODUCTS

- A. General: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that evidence compliance with building code in effect for Project.
 1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, which meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.
 2. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.
- B. Laminated-Veneer Lumber (LVL): Lumber manufactured by laminating wood veneers in a continuous press, evaluated and monitored according to ASTM D 5456, using an exterior-type adhesive complying with [ASTM](#) D2559 to produce members with grain of veneers parallel to their lengths.
 1. Qualified Manufacturers:

- a. [ilevel, a Weyerhaeuser Business \(Trus Joist\)](#) (800-456-4787)
2. Construction: Continuous laminated veneer lumber free from finger or scarf joints. Stress graded veneers bonded with waterproof adhesive with face grain parallel to each adjacent layer. Provide Watershed Overlay coating and edge seal to prevent cupping and moisture damage.
3. Comply with the following requirements:
 - a. Modulus of Elasticity: **1,900,000 psi**.
 - b. Tension Parallel to Grain: **1555 psi**.
 - c. Compression Parallel to Grain: **2510 psi**.
 - d. Compression Perpendicular to Grain: **750 psi** perpendicular to and **480 psi** and parallel to glue line.
 - e. Horizontal Shear: **285 psi** perpendicular to and **190 psi** parallel to glue line.
4. Design Values:
 - a. MOE = **1.9×10^6 psi**.
 - b. Fb = **2600 psi** (for 12" depth).
 - c. Fc_⊥ = **750 psi**.
 - d. Fv = **285 psi**.
- C. Parallel-Strand Lumber (PSL): Lumber manufactured by laying up wood strands using an exterior-type adhesive complying with [ASTM](#) D2559, and cured under pressure to produce members with grain of strands parallel to their lengths and evaluated and monitored according to ASTM D 5456.
 1. Qualified Manufacturers:
 - a. [ilevel, a Weyerhaeuser Business \(Trus Joist\)](#) (800-456-4787)
 2. Construction: Continuous parallel strand lumber bonded with waterproof adhesives and formed into billets. Beams shall be of single ply construction and free from finger joints or splices for full length of span.
 3. Comply with the following requirements:
 4. Extreme Fiber Stress in Bending: **2900 psi** for 12-inch nominal-depth members.
 5. Modulus of Elasticity: **2,000,000 psi**.
 6. Tension Parallel to Grain: **2,025 psi**.
 7. Compression Parallel to Grain: **2900 psi**.
 8. Compression Perpendicular to Grain: **750 psi** perpendicular to and **475 psi** and parallel to wide face of strands.
 9. Horizontal Shear: **210 psi** perpendicular to and **290 psi** and parallel to wide face of strands.
 10. Design Values:
 - a. MOE = **2.0×10^6 psi**.
 - b. Fb - **2900 psi** (for 12" depth)

- c. $F_c \perp = 750 \text{ psi.}$
- d. $F_v = 290 \text{ psi.}$

D. Laminated Strand Lumber (LSL):

1. Prefabricated Wood Rim Joists:

- a. Qualified Manufacturers:
 - 1) [ilevel, a Weyerhaeuser Business \(Trus Joist\)](#) (800-456-4787)
- b. Construction: Solid 1-1/2" thick piece of laminated strand lumber sized to match depth of joist.
- c. Design Values:
 - 1) $MOE = 1.3 \times 10^6 \text{ psi.}$
 - 2) Vertical Load transfer = 3450 plf (Governed by most restrictive capacity of member or wood plate below)
 - 3) Lateral Load transfer = 240 plf.
- d. (Case 1) and 180 plf (Case 3), as governed by horizontal diaphragm.

2. Laminated Strand Lumber Headers:

- a. Qualified Manufacturers:
 - 1) [ilevel, a Weyerhaeuser Business \(Trus Joist\)](#) (800-456-4787)
- b. Construction: Laminated strand lumber; strands of aspen or yellow poplar bonded with waterproof resins; cured using a steam injection process.
- c. Design Values for depths 11.875" or greater:
 - 1) $MOE = 1.5 \times 10^6 \text{ psi.}$
 - 2) $F_b = 2250 \text{ psi}$ (for 12" depth)
 - 3) $F_c \perp = 775 \text{ psi.}$
 - 4) $F_v = 400 \text{ psi.}$
- d. Design Values for depths less than 11.875":
 - 1) $MOE = 1.3 \times 10^6 \text{ psi.}$
 - 2) $F_b = 1700 \text{ psi}$ (for 12" depth).
 - 3) $F_c \perp = 680 \text{ psi.}$
 - 4) $F_v = 400 \text{ psi.}$

2.6 WOOD-BASED STRUCTURAL-USE PANELS, GENERAL

- A. Structural-Use Panel Standards: Provide either all-veneer, mat-formed, or composite panels complying with DOC PS 2, "Performance Standard for Wood-Based Structural-Use Panels," unless otherwise indicated. Provide plywood panels complying with DOC PS 1, "U.S. Product Standard for Construction and Industrial Plywood," where plywood is indicated.

- B. **Structural-Use Panel Standard:** Provide plywood panels complying with DOC PS 1, "U.S. Product Standard for Construction and Industrial Plywood."
- C. **Trademark:** Factory mark structural-use panels with APA trademark evidencing compliance with grade requirements.

2.7 CONCEALED, PERFORMANCE-RATED STRUCTURAL-USE PANELS

- A. **General:** Where structural-use panels are indicated for the following concealed types of applications, provide [APA](#)-performance-rated panels complying with requirements designated under each application for grade, span rating, exposure durability classification, and edge detail (where applicable).
 - 1. **Thickness:** Provide panels meeting requirements specified but not less than thickness indicated.
 - 2. **Span Ratings:** Provide panels with span ratings required to meet "Code Plus" provisions of [APA](#) Form No. E30, "Engineered Wood Construction Guide."
- B. **Subflooring:** [APA](#)-rated plywood sheathing.
 - 1. **Exposure Durability Classification:** Exposure 1.
 - 2. **Span Rating:** [Not less than \[16\]](#)
 - 3. **Minimum Thickness:** As shown on drawings.
 - 4. **Edge Detail:** Tongue and groove
- C. **Subflooring:** Oriented-Strand-Board.
 - 1. **Exposure Durability Classification:** Exposure 1.
 - 2. **Span Rating:** [Not less than \[16\]](#)
 - 3. **Minimum Thickness:** As shown on drawings.
 - 4. **Edge Detail:** Tongue and groove
- D. **Wall Sheathing:** Where indicated on Drawings, provide [APA](#)-rated plywood sheathing.
 - 1. **Exposure Durability Classification:** [\[Exposure 1\]](#) [\[Exposure 1, Structural I\]](#)
 - 2. **Span Rating:** [\[16/0\]](#) - 16 for stud spacing of 16 inches or less.
 - 3. **Span Rating:** [\[24/16\]](#) - 24 for stud spacing of 24 inches or less.
 - 4. **Minimum Thickness:** As shown on drawings.
- E. **Wall Sheathing - Oriented-Strand-Board:**
 - 1. **Exposure Durability Classification:** [\[Exposure 1, Structural I\]](#) [\[Exposure 1\]](#)
 - 2. **Span Rating:** [\[16/0\]](#)
 - 3. **Minimum Thickness:** As shown on drawings.
- F. **Roof Sheathing:** [APA](#)-rated plywood sheathing.
 - 1. **Exposure Durability Classification:** [\[Exposure 1\]](#).
 - 2. **Span Rating:** Not less than [\[16/0\]](#).
 - 3. **Minimum Thickness:** As shown on drawings.
- G. **Roof Sheathing - Oriented-Strand-Board:**

1. Exposure Durability Classification: [\[Exposure 1, Structural I\]](#) [\[Exposure 1\]](#)
2. Span Rating: [\[16/0\]](#)
3. Minimum Thickness: As shown on drawings.

2.8 STRUCTURAL-USE PANELS FOR BACKING

- A. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with DOC PS 1, Grade, C-D Plugged Exposure 1, in thickness indicated or, if not otherwise indicated, not less than 15/32 inch thick.

2.9 STRUCTURAL-USE PANELS FOR UNDERLAYMENT

- A. General: Over smooth subfloors, provide underlayment not less than 1/4 inch thick. Over board or uneven subfloors, provide underlayment not less than 11/32 inch thick.
- B. Plywood Underlayment for Resilient Flooring: For underlayment under 19/32 inch-thick, provide plywood panels with fully sanded face and as follows:
 1. Grade: [APA](#) Underlayment Exposure 1.

2.10 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of [AWPA](#) C2 (lumber) and [AWPA](#) C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by [ALSC](#)'s Board of Review.
 1. Lumber that is not in contact with the ground and is not used in areas subject to water comply with [AWPA](#) C31 with inorganic boron (SBX).
 2. Do not use chemicals containing chromium or arsenic.
 3. For exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- B. Pressure treat above ground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:
 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 3. Wood framing members less than 18 inches above grade.
 4. Wood floor plates installed over concrete slabs directly in contact with earth.
- C. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40 lb/cu. ft.
- D. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with [AWPA](#) M4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.11 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated wood is indicated, comply with applicable requirements of [AWPA C20](#) (lumber) and [AWPA C27](#) (plywood).. Identify fire-retardant-treated wood with appropriate classification marking of [UL](#); [SGS U.S. Testing](#); [Timber Products Inspection, Inc.](#); or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Provide fire treated wood in all concealed areas of construction, as shown or indicated on the drawings, and as required by code.
 - 2. Research or Evaluation Reports: Provide fire-retardant-treated wood acceptable to authorities having jurisdiction and for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.
 - 3. For exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- B. Interior Type A: For interior locations, use chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:
 - 1. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.
 - 2. No form of degradation occurs due to acid hydrolysis or other causes related to treatment.
 - 3. Contact with treated wood does not promote corrosion of metal fasteners.
- C. Exterior Type: Use for exterior locations and where indicated. Comply with [ASTM D2898](#).
- D. After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively
- E. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

2.12 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per [ASTM A153](#) or of Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples: [ASTM F1667](#).
- C. Power-Driven Fasteners: ICC NER-272.
- D. Wood Screws: [ASME B18.6.1](#).
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: [ASTM C954](#), except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
 - 1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to [ASTM B117](#).

- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to [ASTM B117](#). Attach sheathing to comply with [ASTM C954](#).
- G. Lag Bolts: [ASME B18.2.1](#).
- H. Bolts: Steel bolts complying with [ASTM A307](#), Grade A; with [ASTM A563](#) hex nuts and, where indicated, flat washers.

2.13 METAL FRAMING ANCHORS

- A. Qualified Manufacturers:
 - 1. [Simpson Strong-Tie Company, Inc.](#) (800-999-5099)
- B. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and as follows:
 - 1. Research or Evaluation Reports: Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for Project.
 - 2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with [ASTM A653](#), G60 coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.
- D. Joist Hangers: U-shaped joist hangers with 2-inch-long seat and 1-1/4-inch-wide nailing flanges at least 85 percent of joist depth.
 - 1. Thickness: 0.052 inch.
 - 2. Thickness: 0.064 inch.
- E. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
 - 1. Strap Width: 1-1/2 inches.
 - 2. Strap Width: 2 inches.
 - 3. Thickness: 0.052 inch.
 - 4. Thickness: 0.064 inch.
 - 5. Designed for connection of engineered wood products, sized to support design loads.
- F. Bridging: Rigid, V-section, nailless type, 0.064 inch thick, length to suit joist size and spacing.
- G. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch minimum side cover, socket 0.064 inch thick, standoff and adjustment plates 0.108 inch thick.
- H. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.

1. Width: 3/4 inch.
 2. Width: 1-1/4 inches.
 3. Thickness: 0.052 inch.
 4. Thickness: 0.064 inch.
 5. Length: As indicated.
- I. Rafter Tie-Downs (Hurricane Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-5/8 inches wide by 0.052 inch thick.
- J. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches wide by 0.052 inch thick by 36 inches long.
- K. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of 2 bolts placed 7 bolt diameters from reinforced base.
1. Bolt Diameter: 5/8 inch.
 2. Bolt Diameter: 3/4 inch.
 3. Width: 2-1/2 inches.
 4. Width: 3-3/16 inches.
 5. Body Thickness: 0.108 inch.
 6. Body Thickness: 0.138 inch.
 7. Base Reinforcement Thickness: 0.180 inch.
 8. Base Reinforcement Thickness: 0.239 inch.
 9. Wall Bracing: T-shaped bracing made for letting into studs in saw kerf, 1-1/8 inches wide by 9/16 inch deep by 0.034 inch thick with hemmed edges.
- L. Wall Bracing: Angle bracing made for letting into studs in saw kerf, 15/16 by 15/16 by 0.040 inch thick with hemmed edges.
- 2.14 MISCELLANEOUS MATERIALS
- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Adhesives for Field Gluing Panels to Framing: Formulation complying with [APA](#) and [ASTM C3498](#) that is approved for use with type of construction panel indicated by both adhesive and panel manufacturers.
- C. Water-Repellent Preservative: [NWWDA](#)-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbonate (IPBC) as its active ingredient.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Apply field treatment complying with [AWPA](#) M4 to cut surfaces of preservative-treated lumber and plywood.
- E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. [Published requirements of metal framing anchor manufacturer.](#)
 - 2. ["Recommended Nailing Schedule" of referenced framing standard and with AFPA's "National Design Specifications for Wood Construction." And "Details for Conventional Wood Frame Construction"](#)
 - 3. ["Table 2304.9.1 - Fastening Schedule" of the International Building Code.](#)
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. 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; predrill as required.
- G. Use hot-dip galvanized or stainless-steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.
- H. Countersink nail heads on exposed carpentry work and fill holes with wood filler.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- C. Install permanent grounds of dressed, preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING

- A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
 - 1. Firestop furred spaces of walls at each floor level and at ceiling with wood blocking or noncombustible materials, accurately fitted to close furred spaces.
- B. Furring to Receive Plywood Paneling: Install 1-by-3-inch nominal-size furring at 24 inches o.c., horizontally and vertically. Select furring with no knots capable of producing bent-over nails and damage to paneling.
- C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal-size furring at 16 inches o.c., vertically.

3.4 WOOD FRAMING, GENERAL

- A. Framing Standard: Comply with [AFPA's](#) "Manual for The Wood Frame Construction Manual (WFCM) for One- and Two-Family Dwellings," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Install framing members of size and at spacing indicated.
- D. Do not splice structural members between supports.
- E. Firestop concealed spaces of wood-framed walls and partitions at each floor level and at ceiling line of top story. Where firestopping is not inherent in framing system used, provide closely fitted wood blocks of 2-inch nominal-thickness lumber of same width as framing members.
- F. Comply with Table 2304.9.1 and Section 2304 of the International Building Code for minimum fastening requirements of wood members, and published requirements of metal fastener manufacturer, whichever is more stringent.

3.5 WALL AND PARTITION FRAMING

- A. General: Arrange studs so that wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs; except single top plate may be used for non-load-bearing partitions. Nail or anchor plates to supporting construction, unless otherwise indicated.
- B. Construct corners and intersections with 3 or more studs. Provide miscellaneous blocking and framing as shown and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide continuous horizontal blocking at midheight of single-story partitions and multistory partitions, using members of 2-inch nominal thickness and of same width as wall or partitions.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.
 - 1. For non-load-bearing partitions, provide double-jamb studs with headers not less than 4-inch nominal depth for openings 36 inches and less in width, and not less than 6-inch nominal depth for wider openings.
 - 2. For load-bearing walls, provide double-jamb studs for openings 72 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth shown or, if not shown, as recommended by [AFPA's](#) "Manual for The Wood Frame Construction Manual (WFCM) for One- and Two-Family Dwellings."
- D. Provide bracing in exterior walls, at both walls of each external corner, full-story height, unless otherwise indicated. Provide one of the following:
- E. Provide bracing in walls, at locations indicated, full-story height, unless otherwise indicated. Provide one of the following:
 - 1. [Diagonal bracing at 45-degree angle using let-in 1-by-4-inch nominal-size boards or using metal bracing.](#)
 - 2. [Plywood panels, not less than 48 by 96 inches applied vertically.](#)

3. Performance-rated structural-use panels, not less than 48 by 96 inches applied vertically.
4. Particleboard sheathing panels, not less than 48 by 96 inches applied vertically.
5. In lieu of bracing at corners or at locations indicated, continuous gypsum sheathing may be provided in panels not less than 48 by 96 inches applied vertically.
6. In lieu of bracing at corners or at locations indicated, continuous fiberboard sheathing, intermediate type, may be provided in panels not less than 48 by 96 inches applied vertically.

3.6 FLOOR JOIST FRAMING

- A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:
 1. Where supported on wood members, by toe nailing or by using metal framing anchors.
 2. Where framed into wood supporting members, by using wood ledgers as shown or, if not shown, by using metal joist hangers.
- B. Fire Cuts: At joists built into masonry, bevel cut ends 3 inches and do not embed more than 4 inches.
- C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches.
- D. Do not notch in middle third of joists; limit notches to 1/6 depth of joist, 1/3 at ends. Do not bore holes larger than 1/3 depth of joist; do not locate closer than 2 inches from top or bottom.
- E. Provide solid blocking of 2-inch nominal thickness by depth of joist at ends of joists unless nailed to header or band.
- F. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches or securely tie opposing members together. Provide solid blocking of 2-inch nominal thickness by depth of joist over supports.
- G. Anchor members paralleling masonry with 1/4-by-1-1/4-inch metal strap anchors spaced not more than 96 inches o.c. extending over and fastening to 3 joists. Embed anchors at least 4 inches into masonry with ends bent at right angles 4 inches into grouted masonry.
- H. Under jamb studs at openings, provide solid blocking between joist.
- I. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.
 1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.
- J. Provide bridging of type indicated below, at intervals of 96 inches o.c., between joists.
 1. Diagonal wood bridging formed from bevel cut 1-by-3-inch nominal-size lumber, double-crossed and nailed both ends to joists.
 2. Steel bridging installed to comply with bridging manufacturer's written instructions.
 3. Bridging may be omitted where joist depth is 12-inch nominal size or less, and where indicated live load is 40 psf or less.
- K. Prefabricated Wood I-Joists:

1. Comply with manufacturer's written instructions for design, installation, and fastening.
2. Design Loads: Joists shall be sized to support loads indicated on drawings and reviewed by a Registered Engineer in the employ of the joist manufacturer.
3. Allowable deflection:
 - a. Floor Joists: $L/480$ live load deflection; $L/240$ total load deflection.
4. Permanently bond the subfloor to the joists using waterproof construction adhesive and nails.
5. End Bearing: 1-3/4" minimum bearing with Timberstrand LSL rim joist.
6. Intermediate bearing: 3-1/2" minimum bearing. Blocking panels shall be installed between the joists when load bearing walls are located above the bearing point.

L. Engineered Wood Beams

1. Comply with manufacturer's written instructions for design, installation, and fastening.
2. Design Loads: Beams shall be sized to support loads indicated on drawings.
3. Allowable deflection:
 - a. Floor Beams: $L/360$ live load deflection; $L/240$ total load deflection.
 - b. Roof Beams: $L/180$ total load deflection.
4. Protect wood members from direct contact with concrete or masonry.
5. Refer to manufacturers literature for connection of multiple plies of side loaded beams.

3.7 RAFTER AND CEILING JOIST FRAMING

- A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
 1. Where ceiling joists are at right angles to rafters, provide additional short joists perpendicular to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal-size or 2-by-4-inch nominal-size stringers spaced 48 inches o.c. crosswise over main ceiling joists.
- B. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
 1. At valleys, provide double-valley rafters of size shown or, if not shown, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.
 2. At hips, provide hip rafter of size shown or, if not shown, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.
- C. Provide collar beams (ties) as shown or, if not shown, provide 1-by-6-inch nominal-size boards between every third pair of rafters, but not more than 48 inches o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.
- D. Provide special framing as shown for eaves, overhangs, dormers, and similar conditions, if any.

E. Engineered Wood Beams

1. Comply with manufacturer's written instructions for design, installation, and fastening.
2. Design Loads: Beams shall be sized to support loads indicated on drawings.
3. Allowable deflection:
 - a. Floor Beams: **L360** live load deflection; **L240** total load deflection.
 - b. Roof Beams: **L/180** total load deflection.
4. Protect wood members from direct contact with concrete or masonry.
5. Refer to manufacturers literature for connection of multiple plies of side loaded beams.

3.8 STAIR FRAMING

- A. Provide stair framing members of size, space, and configuration indicated or, if not otherwise indicated, to comply with the following requirements:
 1. Stringer Size: **2-by-12**-inch nominal-size minimum.
 2. Notching: Notch stringers to receive treads, risers, and supports; leave at least **3-1/2** inches of effective depth.
 3. Stringer Spacing: At least **3** stringers for each **36**-inch clear width of stair.
- B. Provide stair framing that does not exceed the following variations between treads and risers within each flight:
 1. Adjacent Treads and Risers: **3/16** inch.
 2. Between Largest and Smallest Treads and Risers: **3/8** inch.

3.9 INSTALLATION OF STRUCTURAL-USE PANELS

- A. General: Comply with applicable recommendations contained in **APA** Form No. E30, "APA Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
 1. Comply with "Code Plus" provisions of above-referenced guide.
- B. Securely attach to substrate by fastening as indicated, complying with the following:
 1. ICC NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- C. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- D. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.
- E. Fastening Methods: Fasten panels as indicated below:
 1. Combination Subflooring-Underlayment: Glue and nail to framing throughout.

2. Subflooring: Glue and nail to framing throughout.
 - a. Space panels 1/8 inch at edges and ends.
3. Sheathing:
 - a. Nail to wood framing.
 - b. Screw to cold-formed metal framing.
 - c. Space panels 1/8 inch at edges and ends.
4. Underlayment: Nail to subflooring.
 - a. Space panels 1/32 inch at edges and ends.
 - b. Fill and sand edge joints of underlayment receiving resilient flooring just before installing flooring.
5. Plywood Backing Panels: Nail or screw to supports.
6. Lay-out panels with face grain oriented perpendicular to the supporting members.
7. Install roof sheathing with panel cups at all edges.

3.10 PROTECTION

- A. Protect wood that has been treated with inorganic boron from weather. If inorganic boron treated wood becomes wet, apply EPA registered borate treatment to wood surfaces in accordance with manufacturers recommendations.

END OF SECTION 06 10 00 (06100)

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Composite nail base insulated roof sheathing.
4. Subflooring.
5. Underlayment.
6. Sheathing joint and penetration treatment.

1.2 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 plywood complies with requirements.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.

1.3 INFORMATIONAL SUBMITTALS

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

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

2.2 WOOD PANEL PRODUCTS

- A. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
 - 1. Plywood.
 - 2. Oriented strand board.
 - 3. Particleboard underlayment.
 - 4. Hardboard underlayment.
- B. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.
- C. Oriented Strand Board: DOC PS 2.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction, Use Category UC3b for exterior construction.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

- 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 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. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings

specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F (76 deg C) shall be not less than span ratings specified.

- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings.

2.5 WALL SHEATHING

- A. Plywood Wall Sheathing: Exterior, Structural I sheathing.
- B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.
- C. Paper-Surfaced Gypsum Wall Sheathing: ASTM C 1396/C 1396M, gypsum sheathing; with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges.
 - 1. Type and Thickness: Type X, 5/8 inch thick.
- D. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
 - 1. Type and Thickness: Type X, 5/8 inch thick.
- E. Cementitious Backer Units: ASTM C 1325, Type A.
 - 1. Thickness: 5/8 inch.

2.6 ROOF SHEATHING

- A. Plywood Roof Sheathing: Exposure 1, Structural I sheathing.
- B. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing.

2.7 SUBFLOORING

- A. Plywood Subflooring: Exterior, Structural I single-floor panels or sheathing.
- B. Oriented-Strand-Board Subflooring: Exposure 1, Structural I sheathing

2.8 FASTENERS

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

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

2.9 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Division 07 Section "Joint Sealants."
- B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.
- C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
- D. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Subflooring:
 - a. Glue and nail to wood framing.
 - b. Space panels **1/8 inch (3 mm)** apart at edges and ends.
 - 2. Wall and Roof Sheathing:
 - a. Nail to wood framing.
 - b. Space panels **1/8 inch (3 mm)** apart at edges and ends.
 - 3. Underlayment:
 - a. Nail or staple to subflooring.
 - b. Space panels **1/32 inch** apart at edges and ends.
 - c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to wood framing with screws.
 - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 3. Install boards with a **3/8-inch (9.5-mm)** gap where non-load-bearing construction abuts structural elements.
 - 4. Install boards with a **1/4-inch (6.4-mm)** gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Seal sheathing joints according to sheathing manufacturer's written instructions.
 - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
 - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

END OF SECTION 061600

SECTION 06 17 53 - SHOP FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Triangular-Pitched Roof Trusses
2. Parallel-Chord Roof Trusses, Top-Chord Bearing
3. Parallel-Chord Roof Trusses, Bottom-Chord Bearing
4. Girder Trusses
5. Parallel-Chord Floor Trusses, Top-Chord Bearing
6. Parallel-Chord Floor Trusses, Bottom-Chord Bearing
7. Truss Accessories

1.2 REFERENCES

A. [ASTM International](#) Publications:

1. A153 "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"
2. A307 "Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength"
3. A563 "Standard Specification for Carbon and Alloy Steel Nuts"
4. A591 "Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight [Mass] Applications"
5. A653 "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process"
6. A666 "Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar"
7. A780 "Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings"
8. A792 "Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process"
9. F1667 "Standard Specification for Driven Fasteners: Nails, Spikes, and Staples"

B. [The American Society of Mechanical Engineers](#) (ASME) Publications:

1. B18.2.1 "Square and Hex Bolts and Screws, Inch Series"

C. [American Wood-Preservers's Association \(AWPA\)](#) Publications:

1. C2 "Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes"
2. C9 "Plywood - Preservative Treatment by Pressure Process Document Number"
3. M4 "Standard for the Care of Preservative-Treated Wood Products Document Number"

D. [Truss Plate Institute](#) (TPI) / [American National Standards Institute](#) (ANSI) Publications:

1. ANSI/TP1 1, "National Design Standard for Metal-Plate-Connected Wood Truss Construction."
2. TPI HIB "Commentary and Recommendations for Handling Installing & Bracing Metal Plate Connected Wood Trusses."
3. TPI DSB "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."

1.3 DEFINITIONS

- A. Metal-plate-connected wood trusses include planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Engineer, fabricate, and erect metal-plate-connected wood trusses to withstand design loads within limits and under conditions required.
 1. Design Loads: As indicated.
 2. Design trusses to withstand design loads without deflections greater than the following:
 - a. Roof Trusses: Vertical deflection of 1/240 of span due to total load.
 - b. Roof Trusses: Horizontal deflection at reactions of 1-1/4 inches due to total load.
 - c. Floor Trusses: Vertical deflection of 1/480 of span due to live load.
- B. Engineering Responsibility: Engage a fabricator who uses a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for metal-plate-connected wood trusses.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 1. Product Data: For lumber, metal-plate connectors, metal framing connectors, bolts, and fasteners.
 2. Shop Drawings detailing location, pitch, span, camber, configuration, and spacing for each type of truss required; species, sizes, and stress grades of lumber to be used; splice details; type, size, material, finish, design values, and orientation and location of metal connector plates; and bearing details.
 - a. To the extent truss design considerations are indicated as fabricator's responsibility, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - b. Include truss Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.
 3. Product certificates signed by officer of truss fabricating firm certifying that metal-plate-connected wood trusses supplied for Project comply with specified requirements and Shop Drawings.
 4. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with

project names and addresses, names and addresses of architects and owners, and other information specified.

5. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.
6. Material certificates for dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee (ALSC) Board of Review.
7. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:
 - a. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
 - b. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to truss fabricator.
 - c. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials, all tested in accordance with ASTM D5664.
8. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence the following products' compliance with building code in effect for Project.
 - a. Fire-retardant-treated wood
 - b. Metal-plate connectors
 - c. Metal framing connectors

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer with a minimum of five years of experience, who has completed wood truss projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fabricator's Qualifications: Engage a firm that complies with the following requirements for quality control and is experienced in fabricating metal-plate-connected wood trusses similar to those indicated for this Project and with a record of successful in-service performance:
 1. Fabricator participates in a recognized quality-assurance program that involves inspection by SPIB; Timber Products Inspection, Inc.; Truss Plate Institute (TPI); or other independent inspecting and testing agency acceptable to Architect and authorities having jurisdiction.
- C. Comply with applicable requirements and recommendations of the following publications:
 1. [ANSI/TPI 1](#)
 2. [TPI HIB](#)
 3. [TPI DSB](#)

- D. Metal-Plate Connector Manufacturer's Qualifications: A manufacturer that is a member of [TPI](#) and that complies with [TPI](#) quality-control procedures for manufacture of connector plates published in [ANSI/TPI 1](#).
- E. Single-Source Responsibility for Connector Plates: Provide metal connector plates from one source and by a single manufacturer.
- F. Wood Structural Design Standard: Comply with applicable requirements of [AFPA](#)'s "Manual for The Wood Frame Construction Manual (WFCM) for One- and Two-Family Dwellings."
- G. Single-Source Engineering Responsibility: Provide trusses engineered by metal-plate connector manufacturer to support superimposed dead and live loads indicated, with design approved and certified by a qualified professional engineer.
- H. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated that have resulted in installing metal-plate-connected wood trusses similar to those indicated for this Project and with a record of successful in-service performance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses with care and comply with manufacturer's written instructions and TPI recommendations to avoid damage and lateral bending.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

1.8 SEQUENCING AND SCHEDULING

- A. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow erection of trusses.

PART 2 PRODUCTS

2.1 DIMENSION LUMBER

- A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.
- B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
 - 1. Northeastern Lumber Manufacturers Association ([NELMA](#))
 - 2. National Lumber Grades Authority (Canadian) ([NLGA](#))
 - 3. Southern Pine Inspection Bureau ([SPIB](#))
 - 4. West Coast Lumber Inspection Bureau ([WCLIB](#))
 - 5. Western Wood Products Association ([WWPA](#))
- C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
- D. Provide dressed lumber, S4S, manufactured to actual sizes required by DOC PS 20 for moisture content specified, to comply with requirements indicated below:
 - 1. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

- E. Grade and Species: Provide dimension lumber of any species for truss chord and web members, graded visually or mechanically, and capable of supporting required loads without exceeding allowable design values according to AFPA's "National Design Specification for Wood Construction" and its "Supplement."

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. General: Where lumber is indicated as preservative treated or is specified to be treated, comply with applicable requirements of [AWPA](#) C2 (lumber). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by [ALSC](#)'s Board of Review.
 - 1. Lumber that is not in contact with the ground and is not used in areas subject to water comply with [AWPA](#) C31 with inorganic boron (SBX).
 - 2. Do not use chemicals containing chromium or arsenic.
- B. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. After treatment, kiln-dry lumber to a maximum moisture content of 19 percent.
- C. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with [AWPA](#) M4 to cut surfaces. Inspect each piece of lumber after drying and discard damaged or defective pieces.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated wood is indicated, comply with applicable requirements of [AWPA](#) C20 (lumber). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Research or Evaluation Reports: Provide fire-retardant-treated wood acceptable to authorities having jurisdiction and for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.
- B. Interior Type A: For interior locations, use chemical formulation that produces treated lumber with the following properties under conditions present after installation:
 - 1. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.
 - 2. No form of degradation occurs due to acid hydrolysis or other causes related to treatment.
 - 3. Contact with treated wood does not promote corrosion of metal fasteners.
- C. Exterior Type: Use for exterior locations and where indicated.
- D. Inspect each piece of treated lumber after drying and discard damaged or defective pieces.

2.4 METAL CONNECTOR PLATES

- A. General: Fabricate connector plates from metal complying with requirements indicated below.
- B. Interior locations:
 - 1. Hot-Dip Galvanized Steel Sheet: Structural-quality steel sheet, zinc coated by hot-dip process complying with [ASTM](#) A653, Structural Steel, (SS), high strength low alloy steel, Type A, G60 coating designation; Grade 33 and not less than 0.0359 inch thick.

2. Electrolytic Zinc-Coated Steel Sheet: [ASTM](#) A591, structural-(physical) quality steel sheet, zinc coated by electrodeposition; 33,000-psi minimum yield strength, coating class C, and not less than 0.0474 inch thick.

C. Exterior Locations, or where otherwise indicated:

1. Stainless-Steel Sheet: [ASTM](#) A666, Type 304 or 316, chromium nickel steel sheet; 33,000-psi minimum yield strength and not less than 0.035 inch thick.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified below for material and manufacture.
- B. Nails, Wire, Brads, and Staples: [ASTM](#) F1667.
- C. Power-Driven Fasteners: ICC NER-272.
- D. Wood Screws: [ASME](#) B18.2.1.
- E. Lag Bolts and Screws: [ASME](#) B18.2.1.
- F. Bolts: Steel bolts complying with [ASTM](#) A307, Grade A; with [ASTM](#) A563 hex nuts and, where indicated, flat washers.
- G. Truss Tie-Downs: Bent strap tie for fastening roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick. Tie fastens to one side of truss, top plates, and side of stud below.
- H. Truss Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening roof trusses to wall studs below, 2-1/4 inches wide by 0.062 inch thick. Tie fits over top of truss and fastens to both sides of truss, top plates, and one side of stud below.
- I. Roof Truss Clips: Angle clips for bracing bottom chord of roof trusses at non-load-bearing walls, 1-1/4 inches wide by 0.050 inch thick. Clip is fastened to truss through slotted holes to allow for truss deflection.
- J. Floor Truss Hangers: U-shaped hangers, full depth of floor truss, with 1-3/4-inch- long seat; formed from metal strap 0.062 inch thick with tabs bent to extend over and be fastened to supporting member.

2.6 METAL FRAMING ANCHORS

- A. Qualified Manufacturers:
 1. [Simpson Strong-Tie Company, Inc.](#) (800-999-5099)
- B. General: Provide metal framing anchors of structural capacity, type, size, metal, and finish indicated that comply with requirements specified, including the following:
 1. Research or Evaluation Reports: Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for this Project.
 2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.

- C. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with [ASTM](#) A653, G60 coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.
- D. Stainless-Steel Sheet: [ASTM](#) A666, Type 304 or 316, chromium nickel steel sheet; 33,000-psi minimum yield strength.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.
- B. Protective Coatings: Provide one of the following coating systems:
 - 1. SSPC-Paint 22, epoxy-polyamide primer.
 - 2. SSPC-Paint 16, coal-tar epoxy-polyamide black or dark red paint.

2.8 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to size, configuration, thickness, and anchorage details required to withstand design loadings for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances of [ANSI/TP1 1](#). Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances of [ANSI/TP1 1](#).
- D. Connect truss members by metal connector plates located and securely embedded simultaneously into both sides of wood members by air or hydraulic press.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Do not install wood trusses until supporting construction is in place and is braced and secured.
- B. Before installing, splice trusses delivered to Project site in more than one piece.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to recommendations of [TPI](#) and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space, adjust, and align trusses in location before permanently fastening and as indicated on Drawings.
- G. Anchor trusses securely at all bearing points using metal framing anchors. Install fasteners through each fastener hole in metal framing anchor according to manufacturer's fastening schedules and written instructions.
- H. Securely connect each truss ply required for forming built-up girder trusses.
 - 1. Anchor trusses to girder trusses as indicated on Drawings.
- I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

1. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated on Drawings.
 - J. Install wood trusses within installation tolerances of [ANSI/TP1 1](#).
 - K. Do not cut or remove truss members.
 - L. Return wood trusses that are damaged or do not meet requirements to fabricator and replace with trusses that do meet requirements.
 1. Do not alter trusses in the field.
- 3.2 REPAIRS AND PROTECTION
- A. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to [ASTM](#) A780 and manufacturer's written instructions.
 - B. Protective Coating: Clean and prepare exposed surfaces of embedded-metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.
 1. Apply materials to provide minimum dry film thickness recommended by manufacturer of coating system.

END OF SECTION 06 17 53 (06192)

SECTION 06 18 00 - GLUED-LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes framing using structural glued-laminated timber.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide factory-glued structural units produced by an AITC- or APA-licensed firm
 - 1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that will not be exposed in the completed Work.
- B. Quality Standard: Comply with AITC A190.1.
- C. Forest Certification: Provide structural glued-laminated timber produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1.4 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

PART 2 - PRODUCTS

2.1 STRUCTURAL GLUED-LAMINATED TIMBER

- A. General: Provide structural glued-laminated timber that complies with AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.

1. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.
2. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.
 - a. Use adhesive that contains no urea-formaldehyde resins.
- B. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch or Southern pine that complies with structural properties and beam stress classifications indicated.
- C. Species and Grades for Beams:
 1. Species and Beam Stress Classification: Douglas fir-larch, 24F-1.8E, Southern pine, 24F-1.8E.
 2. Lay-up: Either balanced or unbalanced.
- D. Species and Grades for Columns and Truss Members:
 1. Species and Combination Symbol: Douglas fir-larch, 1, Southern pine, 47
- E. Appearance Grade: Framing complying with AITC 110.
- F. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- G. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.2 TIMBER CONNECTORS

- A. General: Unless otherwise indicated, fabricate from the following materials:
 1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.
 2. Round steel bars complying with ASTM A 575, Grade M 1020.
 3. Hot-rolled steel sheet complying with ASTM A 1011/A 1011M, Structural Steel, Type SS, Grade 33.
- B. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil (0.05-mm) dry film thickness.
- C. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A 123/A 123M or ASTM A 153/A 153M.

2.3 FABRICATION

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.

- B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.
- C. End-Cut Sealing: Immediately after end cutting each member to final length, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.
- D. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Erect structural glued-laminated timber true and plumb, and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
 - 1. Lift with padded slings and protect corners with wood blocking.
- B. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing.
 - 1. Predrill for fasteners using timber connectors as templates.
 - 2. Dress exposed surfaces as needed to remove planing and surfacing marks.
 - 3. Coat cross cuts with end sealer.
- C. Cutting: Avoid cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
- D. Repair damaged surfaces after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.
- E. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose including protection from weather, sunlight, soiling, and damage from work of other trades.
 - 1. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION 061800

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior standing and running trim.
 - 2. Interior frames and jambs.
 - 3. Stairwork
 - 4. Wood cabinets.
 - 5. Plastic-laminate countertops.
 - 6. Solid-surfacing-material countertops.
 - 7. Shop finishing of woodwork.
- B. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips unless concealed within other construction before woodwork installation.
- C. Rough carriages for stairs are a part of interior architectural woodwork. Platform framing, headers, partition framing, and other rough framing associated with stairwork are specified in Division 06 Section "Rough Carpentry."

1.2 SUBMITTALS

- A. Product Data: For: solid-surfacing material, cabinet hardware and accessories, handrail brackets and finishing materials and processes.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- C. Samples:
 - 1. Lumber and panel products for transparent finish, for each species and cut, finished on one side and one edge.
 - 2. Lumber and panel products with shop-applied opaque finish, for each finish system and color, with exposed surface finished.
 - 3. Plastic-laminates, for each type, color, pattern, and surface finish.
 - 4. Thermoset decorative panels, for each type, color, pattern, and surface finish.
 - 5. Solid-surfacing materials.
- D. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates, WI-certified compliance certificates.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of woodwork.
- B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards." WI's "Manual of Millwork."
 - 1. Provide AWI Quality Certification Program labels and certificates for woodwork, including installation.
 - 2. Provide WI-certified compliance labels and certificates for woodwork, including installation.
- C. Forest Certification: Provide interior architectural woodwork produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1.4 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:

2.2 MATERIALS

- A. Wood Species and Cut for Transparent Finish: Red oak, plain sawn or sliced, White oak, rift sawn or cut, White ash, plain sawn or sliced, Poplar, plain sawn or sliced
- B. Wood Species for Opaque Finish: Any closed-grain hardwood, Eastern white pine, sugar pine, or western white pine
- C. Wood Products:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP, made with adhesive containing no urea formaldehyde.

- D. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
 - 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. ABA Industries.
 - b. Avonite, Inc.
 - c. E. I. du Pont de Nemours and Company.
 - d. Formica Corporation.
 - e. LG Chemical, Ltd.
 - f. Meganite Inc.; a division of the Pyrochem Group.
 - g. Nevamar Company, LLC; Decorative Products Div.
 - h. Samsung; Cheil Industries Inc.
 - i. Swan Corporation (The).
 - j. Transolid, Inc.
 - k. Wilsonart International; Div. of Premark International, Inc.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural woodwork, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Butt Hinges: 2-3/4-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:
 - 1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
 - 2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, self-closing.
- D. Back-Mounted Pulls: BHMA A156.9, B02011.
- E. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter
- F. Catches: Magnetic catches, BHMA A156.9, B03141 Push-in magnetic catches, BHMA A156.9, B03131 Roller catches, BHMA A156.9, B03071 Ball friction catches, BHMA A156.9, B03013.
- G. Drawer Slides: BHMA A156.9, B05091.
 - 1. Standard Duty Grade 1 Side mounted full-extension type; epoxy-coated steel with polymer rollers.

- H. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
3. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
4. Satin Stainless Steel: BHMA 630.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, fire-retardant-treated, kiln-dried to less than 15 percent moisture content.
- B. Rough Carriages for Stairs: Select Structural grade Douglas fir-larch, hem-fir, or southern pine; kiln dried to 15 percent maximum moisture content:
- C. Rough Carriages for Stairs: Laminated veneer lumber, made with an exterior-type adhesive complying with ASTM D 2559, and with the following allowable design values as determined according to ASTM D 5456:
1. Extreme Fiber Stress in Bending, Edgewise: 2500 psi (17.2 MPa) for 12-inch nominal- (286-mm actual-) depth members.
 2. Modulus of Elasticity, Edgewise: 1,800,000 psi (12 400 MPa).
- D. Handrail Brackets: Cast from bronze with wall flange drilled for exposed anchor bolt and with support arm for screwing to underside of rail. Sized to provide 1-1/2-inch (38-mm) clearance between handrail and wall.
- E. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

2.5 FABRICATION

- A. General: Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
1. Interior Woodwork Grade: Custom.
 2. Shop cut openings to maximum extent possible. Sand edges of cutouts to remove splinters and burrs. Seal edges of openings in countertops with a coat of varnish.
 3. Install glass to comply with applicable requirements in Division 08 Section "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.
- B. Interior Standing and Running Trim:

1. For transparent-finished trim items wider than available lumber, use veneered construction. Do not glue for width.
 2. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
 3. Assemble casings in plant except where limitations of access to place of installation require field assembly.
- C. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard or fire-retardant medium-density fiberboard with veneered, exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
1. Fire Rating: 60 minutes.
- D. Stairwork:
1. Treads: Opaque finish.
 2. Risers: Opaque finish.
 3. Stringers: Opaque finish.
 4. Balusters: Opaque finish.
 5. Handrails: Transparent finish.
 6. Scotia, Cove, and Other Moldings: Opaque finish.
- E. Wood Cabinets for Transparent Finish:
1. AWI Type of Cabinet Construction: Flush overlay on face frame.
 2. WI Construction Style: Face Frame.
 3. WI Construction Type: Type I, multiple self-supporting units rigidly joined together
 4. WI Door and Drawer Front Style: Flush overlay.
 5. Reveal Dimension: As indicated.
 6. Grain Direction: Horizontally for drawer fronts, doors, and fixed panels.
 7. Matching of Veneer Leaves: Book match.
 8. Veneer Matching within Panel Face: Center-balance match.
 9. Semiexposed Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.
 10. Drawer Sides and Backs: Solid hardwood lumber.
 11. Drawer Bottoms: Hardwood plywood.
 12. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.
- F. Plastic-Laminate Countertops:
1. High-Pressure Decorative Laminate Grade: HGS, HGP.
 2. Colors, Patterns, and Finishes: As indicated by manufacturer's designations.
 3. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range.
 4. Edge Treatment: Same as laminate cladding on horizontal surfaces.
 5. Core Material at Sinks: Medium-density fiberboard made with exterior glue or exterior-grade plywood.

G. Solid-Surfacing-Material Countertops:

1. Solid-Surfacing-Material Thickness: 3/4 inch (19 mm).
2. Colors, Patterns, and Finishes: As selected from manufacturer's full range.
3. Fabricate tops in one piece with loose backsplashes for field application. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
4. Install integral sink bowls in countertops in shop.

2.6 SHOP FINISHING

- A. Finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling.
- C. Transparent Finish:
1. Grade: Custom.
 2. AWI Finish System: Match approved sample
 3. WI Finish System: Match approved sample
 4. Staining: Match approved sample
 5. Wash Coat for Stained Finish: Apply a wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
 6. Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
 7. Sheen: As indicated
- D. Opaque Finish:
1. Grade: Custom.
 2. AWI Finish System: Conversion varnish or Catalyzed vinyl.
 3. WI Finish System: synthetic enamel.
 4. Color: As selected from manufacturer's full range.
 5. Sheen: As indicated

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.
- B. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

- C. Install woodwork level, plumb, true, and straight to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Shim as required with concealed shims.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Scarf running joints and stagger in adjacent and related members. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
- G. Stairs: Securely anchor carriages to supporting substrates. Install stairs with treads and risers no more than 1/8 inch (3 mm) from indicated position.
- H. Railings: Install rails with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) variation from a straight line.
 - 1. Stair Rails: Glue and dowel or pin balusters to treads and railings, and railings to newel posts.
 - 2. Wall Rails: Support rails on indicated metal brackets securely fastened to wall framing.
- I. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
 - 1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips, No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish, toggle bolts through metal backing or metal framing behind wall finish.
- J. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

END OF SECTION 06 40 23

SECTION 06 61 00 - CAST POLYMER SURROUNDS

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. Cast Polymer
 - a. Tub and Shower Surrounds

- B. Related Sections:

- 1. Section 061053 - Miscellaneous Rough Carpentry
 - 2. Section 064023 – Interior Architectural Woodwork
 - 3. Section 123640 - Stone Countertops
 - 4. Division 22 - Plumbing Fixtures

1.3 REFERENCES

- A. FS MMM-A-130 - Adhesive, Contact
- B. Architectural Woodwork Institute (AWI): "Architectural Woodwork Quality Standards"

1.4 SUBMITTALS

- A. Submit Shop Drawings and product data. Include materials, component profiles, fastening methods, assembly methods, joint details, accessory listings, and schedule of finishes.
- B. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

1.5 QUALITY ASSURANCE

- A. Tub/Shower surrounds, shall be supplied by one manufacturer.
- B. Allowable Tolerances:
 - 1. Variation in component size: +/- 1/8 inch.
 - 2. Location of openings: +/- 1/8 inch from indicated location.

- C. Perform work to quality in accordance with "Quality Standards" of the Architectural Woodwork Institute (AWI).
- D. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cast polymer materials until painting and similar operations that could damage synthetic marble have been completed in installation areas. If cast polymer materials must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.
- B. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cast polymer materials until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where cast polymer materials are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cast polymer materials work by field measurements before being enclosed and indicate measurements on Shop Drawings.

1.8 SPECIAL WARRANTY

- A. Cast polymer materials:
 - 1. Provide one (1) year Warranty against manufacturing defects.

PART 2 PRODUCTS

2.1 CAST POLYMER:

- A. Refer to:

Hampton Inn & Suites Interior Finish Specifications.

B. Tub/Shower Surrounds:

1. Homogeneous minimum 1/4" thick molded panels. Surrounds to be cast polymer wall panels; installed as indicated on Drawings. No horizontal seams or trim strips permitted. Provide one piece for each wall. Joints will be permitted at corners only.
 - a. Surround Pattern:
 - 1 Unless shown otherwise, provide custom "Tile-Like" pattern with 8" wide x 10" high tile size and 3/32" to 1/8" simulated grout joint width.
 - 2 Provide 2" x 8" Bull Nose "Tile-Like" Cap.
 - b. Provide required ceramic soap dishes, in same color as wall panels.
 - 1 Provide soap dishes in locations, configurations, and sizes as shown on Drawings.

2.2 INSTALLATION MATERIALS

- A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- B. Adhesive and Sealant: Installer shall verify products are approved by Cast polymer materials manufacturer.
 1. Manufacturers:
 - a. "OSI SF400"; OSI Sealants, Inc.
 - b. "PL Premium 'Polyurethane' Adhesive"; OSI Sealants, Inc.
 - c. "LN-602 Liquid Nails", Liquid Nails, Macco Division of ICI Paints
 - d. "DAP 2000", DAP, Inc.

2.3 FABRICATION

- A. General:
 1. Shop assemble cast polymer materials for delivery to site in units easily handled and to permit passage through building openings.
 2. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings.
 - a. Rout and finish component edges with clean, sharp returns. Rout cutouts, radii and contours to template. Smooth edges. Repair or reject defective and inaccurate work.
 3. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trip for scribing and site cutting.
 4. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings.

5. Provide for mounting of soap dishes, grab rails, etc., as indicated on the Drawings.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify adequacy of backing and support framing.

3.2 PREPARATION

- A. Condition cast polymer materials to average prevailing humidity conditions in installation areas before installation.

3.3 INSTALLATION

- A. All surrounds shall be installed as shown on Drawings and as specified by manufacturer.
- B. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
- C. Tub/Shower Surrounds:
 1. Remove all dust and other contaminants from the back side of all panels before installation.
 2. Secure soap dishes to panels with adhesive as recommended by Manufacturer.
 3. Hold bottom edge of wall panel above rim of tub and shower for application of sealant as shown on Drawings.

3.4 ADJUSTING AND CLEANING

- A. Keep components clean during installation. Remove adhesives, sealants and other stains. Keep clean until Date of Substantial Completion. Replace stained and damaged components.
- B. Protect surfaces from damage until Date of Substantial Completion. Repair work or replace damaged work which cannot be repaired to Owner's Representative's satisfaction.

END OF SECTION 066100

SECTION 07 10 00 - DAMPPROOFING AND WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sheet Waterproofing for Exterior Side of Foundation Walls
 - a. Post-Applied, Rubberized-Asphalt Sheet Membrane Waterproofing

1.2 REFERENCES

A. [ASTM International](#) Publications:

1. D4263 "Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method"
2. E1745 "Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs"
3. D3767 "Standard Practice for Rubber – Measurement of Dimensions"
4. D412 "Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension"
5. D882 "Standard Test Method for Tensile Properties of Thin Plastic Sheeting"
6. E96 "Standard Test Methods for Water Vapor Transmission of Materials"
7. D570 "Standard Test Method for Water Absorption of Plastics"
8. D1970 "Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection"
9. C836 "Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course"
10. E154 "Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover"
11. D903 "Standard Test Method for Peel or Stripping Strength of Adhesive Bonds"
12. D1876 "Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)"
13. D1709 "Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method"

1.3 SYSTEM DESCRIPTION

- A. General: Provide waterproofing that prevents the passage of liquid water under hydrostatic pressure and complies with requirements as demonstrated by testing performed by an independent testing agency of manufacturer's current sheet membrane.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:

1. Submit product data on each type of dampproofing and waterproofing product specified, including manufacturer's details, installation instructions, use limitations and recommendations data substantiating that materials comply with specified requirements.
 - a. Mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this Project.
 - b. Prepare and submit Project-specific details as required by the Drawings.
2. Samples, 3 x 6 inches minimum size, of each fluid-applied and sheet membrane waterproofing material specified for Project.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed fluid-applied and sheet membrane waterproofing applications similar in material, design, and extent to that indicated for Project and that has resulted in construction with a record of successful in-service performance.
 1. Assign work closely associated with waterproofing, including (but not limited to) waterproofing accessories, and flashings used in conjunction with waterproofing, expansion joints in membrane, insulation, and protection course on membrane, to Installer of fluid-applied waterproofing, for single, undivided responsibility.
- B. Single-Source Responsibility: Obtain primary waterproofing materials of each type required from a single manufacturer.
- C. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.
- D. Schedule Coordination: Schedule work such that membrane will not be left exposed to weather for longer than that recommended by the manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacturer, and directions for storage.
- B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer. Protect stored materials from direct sunlight.
- C. Protect waterproofing materials from freezing. In cool temperatures, store the material for several hours at room temperature to facilitate mixing and application.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Apply waterproofing within range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during penetration and application of waterproofing materials.
- C. Provide protection of surrounding areas and adjacent surfaces from application of materials.

PART 2 PRODUCTS

2.1 MATERIALS, GENERAL

- A. General Compatibility: Provide products that are recommended by manufacturer to be fully compatible with indicated substrates.

2.2 SPRAY WATERPROOFING FOR BELOW GRADE APPLICATIONS.

- A. Confined Site ("Blind Side") Vertical Applications.

1. Performance Characteristics:

- a. Minimum Thickness (ASTM D3767-A): 0.046 in(1.2 mm).
- b. Low Temperature Flexibility (ASTM D1970, 180° bend @ -25°C): No Effect.
- c. Minimum Elongation (ASTM D412): 300%.
- d. Tensile Strength (ASTM D412): 4000 psi.
- e. Crack Cycling (ASTM C836 @ -23°C): No Effect.
- f. Puncture Resistance (ASTM E154): 180 pounds (990 N).
- g. Peel Adhesion to Concrete (ASTM D903 modified): 5.0 lbs/in (880 N/m).
- h. Lap Adhesion (ASTM D1876-01 modified): 2.5 lbs/in (440 N/m).
- i. Moisture Vapor Transmission (ASTM E96-B): 0.01 perms (0.6 ng/m²sPa).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions under which waterproofing systems will be applied, with Installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.
1. Do not proceed with installation until after minimum concrete curing period recommended by waterproofing manufacturer.
 2. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
- B. Inspect concrete and concrete masonry surfaces for:
1. Contamination: Algae, chalkiness, dirt, dust, efflorescence, form oil, fungus, grease, mildew or other foreign substances.
 2. Surface absorption and chalkiness.
 3. Cracks: Measure crack width and record location of cracks.
 4. Damage and deterioration.
 5. Moisture content and moisture damage:
 - a. Use a moisture meter to determine if the surface is dry enough to receive the air and moisture barrier and record any areas of moisture damage or excess moisture.
 6. Compliance with specification tolerances:
 - a. Record areas that are out of tolerance (greater than 1/4 inch in 8-0 feet deviation in plane).

- C. Notify [Architect] in writing of anticipated problems using waterproofing over substrate. Do not start work until deviations are corrected.

3.2 PREPARATION

- A. Clean substrate of projections and substances detrimental to work; comply with instructions of prime materials manufacturer.
- B. Install cant strips and similar accessories as shown and as recommended by prime materials manufacturer even though not shown.
- C. Fill voids, seal joints, and apply bond breakers as recommended by prime materials manufacturer.
- D. Repair cracks, spalls, or other damage in concrete or concrete masonry surfaces.
- E. Prime substrate as recommended by prime materials manufacturer.

3.3 INSTALLATION

- A. Comply with manufacturer's written installation recommendations, including preparation of substrate surfaces, detail coatings of joints and planar changes in substrate, and priming of substrates.
- B. Mix separately packaged components in accordance with manufacturer's written recommendations.
- C. Installation, Spray Waterproofing
 - 1. Apply waterproofing membrane material to substrates and adjoining surfaces indicated to receive membrane. Apply in accordance with manufacturer's recommendations to obtain thicknesses specified and using applicators and techniques best suited for slope and type of substrate to which applied.
 - a. Provide 60 mil (average) membrane thickness, with minimum 50 mil thickness.
 - 2. Install sheet membrane waterproofing material to substrates and adjoining surfaces indicated to receive membrane. Install in accordance with manufacturer's recommendations using applicators and techniques best suited for type of substrate to which applied.
 - 3. Install sheet-type flashings and joint covers where indicated and as recommended by prime materials manufacturer. Extend flashings onto perpendicular surfaces and other work penetrating substrate to not less than 6-inches beyond finished surface to be applied over waterproofing.
 - 4. Permit membrane to cure under conditions that will not contaminate or deteriorate waterproofing material. Block off traffic and protect membrane from physical damage.
 - 5. Install protection course on cured membrane (after testing) without delay to minimize period of membrane exposure.
 - a. On vertical surfaces comply with waterproofing manufacturer's recommendations for adhesion of protection course to membrane.
 - b. In-Place Testing: Before completed membranes on horizontal surfaces are covered by protection course or other work, test for leaks with 2-inch depth of water maintained for 24 hours. Repair any leaks revealed by examination of substructure, and repeat test until no leakage is observed.

6. Provide separation between waterproofing membrane and non-compatible substrates and materials in accordance with manufacturers published instructions.

3.4 PROTECTING AND CLEANING

- A. Protect waterproofing from damage and wear during application and remainder of construction period, according to manufacturer's written instructions.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 10 00 (07100)

SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Modified bituminous sheet waterproofing.
 - 2. Molded-sheet drainage panels.
- B. Related Sections include the following:
 - 1. Division 07 Section "Joint Sealants" for joint-sealant materials and installation.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
 - 1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.
- C. Samples: For the following products:
 - 1. 4-by-4-inch (300-by-300-mm) square of waterproofing and flashing sheet.
 - 2. 4-by-4-inch (100-by-100-mm) square of drainage panel.
- D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- E. Qualification Data: For Installer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for waterproofing.

- G. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is acceptable to waterproofing manufacturer for installation of waterproofing required for this Project.
- B. Source Limitations: Obtain waterproofing materials, molded-sheet drainage panels through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

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

1.7 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to replace waterproofing material that does not comply with requirements or that fails to remain watertight within specified warranty period.
 - 1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch (1.6 mm) in width.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Not less than 60-mil- (1.5-mm-) thick, self-adhering sheet consisting of 56 mils (1.4 mm) of rubberized asphalt laminated to a 4-mil- (0.10-mm-) thick, polyethylene film with release liner on adhesive side and formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
1. Basis-of-Design: Subject to compliance with requirements provide CCW MiraDRI 860/861 and appropriate CCW MiraDrain Drainage System as manufactured by Carlisle Coatings & Waterproofing Inc., 900 Hensley Lane, Wylie, Texas 75098, Phone: (800) 527-7092, Fax: (972) 442-0076, www.carlisle-ccw.com or comparable product.
 2. Physical Properties:
 - a. Tensile Strength: 325 psi minimum; ASTM D 412.
 - b. Ultimate Elongation: 350 percent minimum; ASTM D 412.
 - c. Permeance: 0.05 Perm maximum, ASTM E 96 (B).
 - d. Low-Temperature Flexibility: Unaffected at -45°, ASTM D 1970, 1" mandrel.
 - e. Tensile to Film: 5000 psi, ASTM D 882.
 - f. Thickness: 60 mils, ASTM D 3767.
 - g. Puncture Resistance: 60 lbf minimum; ASTM E 154.
 - h. Hydrostatic-Head: 230 feet minimum; ASTM D 751.
 - i. Water Absorption: 0.1 percent by weight; ASTM D 570.

2.2 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of sheet waterproofing material.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of sheet waterproofing material.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.

- F. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.
- G. Protection Course: Extruded-polystyrene board insulation, unfaced.

2.3 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side with a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per ft. (112 to 188 L/min. per m).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
 - 2. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
 - 1. Install sheet strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch (1.6 mm).

- F. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
 - 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane each direction from corner or install membrane strip centered over corner.
- G. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and according to recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure watertight installation.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).
- D. Two-Ply Application: Install sheets to form a membrane with lap widths not less than 50 percent of sheet widths to provide a minimum of 2 thicknesses of sheet membrane over areas to receive waterproofing.
- E. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.
- F. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic.
- G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions.
- H. Install protection course with butted joints over waterproofing membrane immediately.
 - 1. Molded-sheet drainage panels or Board insulation may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

- I. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

3.4 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall substrate, according to manufacturer's written instructions. Use adhesives that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install board insulation before installing drainage panels.

3.5 PROTECTION AND CLEANING

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

END OF SECTION 071326

SECTION 07 21 00 -THERMAL INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Foundation Wall and Under Slab Insulation
 - 2. Batt Insulation
 - a. Unfaced
 - b. Faced
 - 3. Sound Attenuation Insulation
 - 4. Insulation Baffles (Eave Ventilation Troughs)
 - 5. Vapor Retarders

1.2 REFERENCES

- A. [ASTM International](#) Publications:
 - 1. C578 "Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation"
 - 2. C665 "Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing"
 - 3. D4397 "Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications"
 - 4. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"
 - 5. E96 "Standard Test Methods for Water Vapor Transmission of Materials"
 - 6. E119 "Standard Test Methods for Fire Tests of Building Construction and Materials"
 - 7. E136 "Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C"
 - 8. E1677 "Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls"
 - 9. E1745 "Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs"

1.3 DEFINITIONS

- A. Thermal Resistivity: Where thermal resistivity properties of insulation materials are designated by R-values, they represent the rate of heat flow through a homogeneous material exactly 1" thick, measured by test method included in referenced material standard or otherwise indicated. They are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:

1. Product Data for each type of product.
2. Certified Test Reports: With product data, submit copies of certified test reports showing compliance with specified performance values, including R-values (aged values for plastic insulations), densities, compression strengths, fire performance characteristics, perm ratings, water absorption ratings and similar properties.

1.5 QUALITY ASSURANCE

- A. Fire Test Response Characteristics: Provide insulation materials which are identical to those whose fire-test-response characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, per methods indicated below, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Surface Burning Characteristics: [ASTM](#) E84
 2. Fire Resistance Ratings: [ASTM](#) E119
 3. Combustion Characteristics: [ASTM](#) E136
- B. Asbestos Content of Inorganic Insulations: provide insulations composed of mineral fibers or mineral ores which contain no asbestos of any type of mixture of types occurring naturally as impurities as determined by polarized light microscopy test per Appendix A of 40 CFR 763.
- C. All insulation in roof and wall assemblies shall be approved for use without an additional thermal barrier in accordance with Local Building Codes.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver insulation in original labeled bundles.
- B. General Protection: Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage, and protection during installation.
- C. Protection for Plastic Insulation:
 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver plastic insulating materials to project site ahead of installation time.
 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of work.

1.7 PROJECT CONDITIONS

- A. The Installer must examine the substrate and the conditions under which insulation work is to be performed and notify the Architect in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
- B. Weather Conditions: Proceed with work only when weather conditions are in compliance with manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with requirements and the manufacturer's recommendations.
- C. Do not apply insulation to damp, frozen, dirty, dusty, or surfaces unacceptable to manufacturer.

- D. Coordinate this work with all trades and protect it after installation.

PART 2 PRODUCTS

2.1 INSULATING MATERIALS

- A. General: Provide insulating materials which comply with requirements indicated for materials, compliance with referenced standards, and other characteristics.
- B. Qualified manufacturers:
 - 1. [CertainTeed Corp.](#) (800-223-8990)
- C. Extruded Polystyrene Foam Board Insulation - Foundation Walls and Under Slab.
 - 1. Extruded Polystyrene Board Insulation (EPS): Rigid, cellular polystyrene thermal insulation with closed-cells and integral high density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with [ASTM](#) C578 for Type indicated; with 5-year aged r-values of 5.4 and 5 at 40 and 75 deg. F., respectively; and as follows:
 - a. Type IV, 1.6 lb./cu. ft. min. density, unless otherwise indicated.
- D. Unfaced Glass Fiber Batt Insulation:
 - 1. [ASTM](#) C665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing [ASTM](#) E136 for combustion characteristics. Product shall be free of formaldehyde.
- E. Unfaced Glass Fiber Batt Insulation:
 - 1. [ASTM](#) C665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing [ASTM](#) E136 for combustion characteristics.
- F. Faced Glass Fiber Blanket Insulation:
 - 1. [ASTM](#) C665, Type Type II, Class C, Category 1; consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing [ASTM](#) E136 for combustion characteristics. Product shall be free of formaldehyde.
 - a. Mineral-Fiber Type: Fibers manufactured from glass.
 - b. Facing: Polyethelene Wrapped Batts with stapling flaps.
- G. Faced Glass Fiber Blanket Insulation:
 - 1. [ASTM](#) C665, Type Type II, Class C, Category 1; consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing [ASTM](#) E136 for combustion characteristics.
 - a. Mineral-Fiber Type: Fibers manufactured from glass.
 - b. Facing: Kraft Paper
 - c. Flanged Units: Provide blankets fabricated with facing incorporating 5-inch - wide flanges along edges for attachment to framing members.
- H. Faced Glass Fiber Blanket Insulation with vapor barrier:

1. Mineral-Fiber Type: Fibers manufactured from glass.
 2. Facing: 2 mil polyimide vapor retarder: [ASTM](#) E86, water vapor permeance of 8 perms (wet cup method) and 1 perm or less (dry cup method).
 - I. Mineral Fiber Sound-Attenuation Insulation:
 1. Unfaced mineral-fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with [ASTM](#) C665 for Type I (blankets without membrane facing), passing [ASTM](#) E136 for combustion characteristics.
 - a. Mineral-Fiber Type: Slag Wool-Fiber/Rock-Wool-Fiber.
- 2.2 EAVE VENTILATION TROUGHS:
- A. Preformed rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.
- 2.3 ACCESSORIES:
- A. Nails and Staples: Steel wire, galvanized, type and size to suit application.
 - B. Tape: Polyethylene or Polyester, self-adhering type, 2 inches wide. Or as recommended by manufacturer.
 - C. Insulation Fasteners: Steel impale spindle and clip on flat metal base, self adhering backing, length to suit insulation thickness, capable of securely and rigidly fastening insulation in place.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Require Installer to examine substrates and conditions under which insulation work is to be performed. A satisfactory substrate is one that complies with requirements of the section in which substrate and related work is specified. Obtain Installer's written report listing conditions detrimental to performance of work in this section. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.
 1. Verify adjacent materials are dry and ready to receive insulation.
 2. Verify mechanical and electrical services within insulated spaces have been installed and tested.
 3. Verify substrate surface is flat, free of honeycomb, fins, irregularities, and materials that will impede adhesive bond.
- B. Installation of insulation signifies contractor acceptance of substrate.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections which might puncture vapor retarders.

3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specified recommendations before proceeding with work.
 1. Verify insulation boards are unbroken and free of damage.

- B. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.
- C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.
- D. Trim insulation neatly to fit spaces. Use boards free of damage.
- E. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Leave no gaps or voids.
- F. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

3.4 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

- A. On vertical surfaces, set units in adhesive applied in accordance with manufacturer's instructions. Use type of adhesive recommended by manufacturer of insulation.
- B. Protect top surface of horizontal insulation (from damage during concrete work) by application of protection board.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Set vapor retarder faced units with vapor retarder to warm side of construction, except as otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
 - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure air-tight installation.
- C. Install glass fiber blankets in cavities formed by framing members according to the following requirements.
 - 1. Use blanket widths and lengths that fill cavities formed by framing members. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3.6 INSTALLATION OF CAVITY-WALL INSULATION

- A. On units of foam-plastic board insulation, install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates indicated.

3.7 INSTALLATION OF VAPOR RETARDERS

- A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those which have been stuffed with loose fiber-type insulation.

- B. Seal vertical joints in vapor retarders over framing by lapping not less than 2 wall studs. Fasten vapor retarders to framing at top, end and bottom edges, at perimeter of wall openings, and at lap joints; space fasteners 16" o.c.
- C. Seal overlapping joints in vapor retarders with adhesives per vapor retarder manufacturer's printed directions. Seal butt joints and fastener penetrations with tape of type recommended by vapor retarder manufacturer. Locate all joints over framing members or other solid substrates. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor retarder manufacturer.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape of type recommended by vapor retarder manufacturer to create an air-tight seal between penetrating objects and vapor retarder.
- E. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.8 PROTECTION

- A. General: Protect installed insulation and vapor retarders from harmful weather exposures and from possible physical abuses, where possible by non-delayed installation of concealing work or, where that is not possible, by temporary covering or enclosure.

3.9 SCHEDULES

	Location	Value	Description
A.	Foundation Walls	N/A	
B.	Exterior Walls	R-19 R-7.5 Con.	Cavity. Continuous insulation exterior.
C.	Roof	R-19 R-20	Batt in cavity. Rigid above sheathing.
D.	Floor	3 ½" Max. (R-13)	Unfaced, batt fiberglass insulation.
E.	Interior Walls	3" Min. (R-13)	For Acoustics only.

END OF SECTION 07 20 00 (07200)

SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flashing at Roof, Windows, Doors, and other locations as shown on Drawings.
2. Aluminum Formed Cap Flashings (Copings)
3. Fasteners

1.2 REFERENCES

A. [ASTM International](#) Publications:

1. B117 "Standard Practice for Operating Salt Spray (Fog) Apparatus"
2. B209 "Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate"
3. C920 "Standard Specification for Elastomeric Joint Sealants"
4. D523 "Standard Test Method for Specular Gloss"
5. D1079 "Standard Terminology Relating to Roofing, Waterproofing, and Bituminous Materials"
6. D1970 "Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection"
7. D2244 "Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates"
8. D2247 "Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity"
9. D2843 "Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics"
10. D3359 "Standard Test Methods for Measuring Adhesion by Tape Test"
11. D6221 "Standard Specification for Reinforced Bituminous Flashing Sheets for Roofing and Waterproofing"

B. [American Architectural Manufacturers Association \(AAMA\)](#) Publications:

1. AAMA 620 "Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Aluminum Substrates"
2. AAMA 1402 "Standard Specifications for Aluminum Siding, Soffit and Fascia"
3. AAMA 2603 "Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels"

C. [Sheet Metal and Air Conditioning Contractors' National Association \(SMACNA\)](#) Publications:

1. "Architectural Sheet Metal Manual", Current Edition

D. [The Society for Protective Coatings \(SSPC\)](#) Publications:

1. "SSPC Painting Manual"

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Submit Shop Drawings, color samples, product information, and samples clearly detailing shaping, jointing, length of sections, fastening, and installation details.
 - 2. Manufacturer's standard color charts for selection purposes.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed sheet metal and membrane flashing and metal trim work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.
- B. Do not proceed with the installation of flashing and sheet metal work until curb and substrate construction, cant strips, blocking, reglets, and other construction to receive the work is completed.
- C. Flashing and sheet metal shall be installed in accordance with Factory Mutual Engineering and Research requirements.
- D. The installer must examine the substrate and the conditions under which flashing and sheet metal work is to be performed, and notify the [\[Architect\]](#) [\[Owner's Representative\]](#) in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Protection: Protect materials from rain and physical damage. Provide cover on top and on all sides, allowing for adequate ventilation. Store flashing where temperatures will not exceed 90 degrees F for extended periods. Store all products in a dry area away from high heat, flames or sparks.
- C. Store Membrane Flashing System products in manufacturer's unopened packaging until ready for installation and dispense the needed amounts of materials from the manufacturer box.

1.6 PROJECT CONDITIONS

- A. Existing Conditions:
 - 1. Exercise care when working on or about roof surfaces to avoid damaging or puncturing membrane or flexible flashings.
 - 2. Place plywood panels on roof surfaces adjacent to work of this Section and on access routes. Keep in place until completion of work.
- B. Roofing and flashing shall not be applied during precipitation and shall not be started in the event there is a probability of precipitation during application. Metal faced flashing shall not be applied when ambient temperature is below 35 degrees F.

- C. Do not install Membrane Flashing Systems on wet or damp surfaces. Surfaces should also be free from dirt, oils, lubricants or other debris that may inhibit adhesion of the flashing tape to the substrate. After precipitation, allow a minimum of 24 hours for drying before installing the flashing tape. For optimal performance, install at temperatures above 40 degrees F.
- D. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

1.7 WARRANTY

- A. Provide Owner with warranty stating that flashing material and metal wall fascia will properly shed water and protect roof and wall from physical damage for a minimum period of five years from date of Substantial Completion and the damage resulting from failure to provide above stated performances will be repaired to satisfaction of Owner at no additional cost.

1.8 SEQUENCING

- A. Coordinate installation of air barriers, flashing, sheet metal trim, roofing membrane, windows, doors and other wall penetrations to provide a continuous system to divert water to the exterior of assemblies..
- B. Provide sill flashing to direct water to the exterior before windows and doors are installed.
- C. Install window and door head flashing immediately after windows and doors are installed.
- D. Install diverter flashings wherever water can enter an assembly to direct water to the exterior.

PART 2 PRODUCTS

2.1 ALUMINUM FLASHING AND SHEET METAL

- A. Materials:
 - 1. Aluminum Sheet: ASTM B209, Alloy 3003, Temper H14, AA-C22A41, minimum .032 inch thick (20 ga) sheet, unless otherwise noted.
 - 2. 2-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3. Fasteners: Concealed type; of same material as flashings; sized to suit application.
 - 4. Size and shape as shown on Drawings.

2.2 ALUMINUM FORMED CAP FLASHING

- A. Aluminum coping shall be .040" smooth aluminum, size as shown on Drawings. All joints shall receive concealed splice plates to accommodate thermal movement. Provide premanufactured inside and outside corners as required. Stainless steel screws and washers shall be used for installation of all copings.
 - 1. Color and Gloss: [\[As shown on Exterior Finish Schedule\]](#).
 - 2. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Fasteners: Concealed type; Series 300 stainless steel screws and washers; sized to suit application.

2.3 MEMBRANE FLASHING

A. Door & Window Opening Flashing System

1. Elasticized Flexible Flashing Tape complying with the following:
 - a. Face Material composition: Elasticized polyethylene laminate.
 - b. Face color: White.
 - c. Adhesive composition; Butyl adhesive containing non-halogen fire retardant additive
 - d. Thickness: > 60 mils.
 - e. Release liner: 2 part siliconized paper.
 - f. Elastic Elongation, MD (length @ Full Extension / Length @ Relaxed): >230% @ 70 F.
 - g. Dimension: 8 or 10 inch width
2. Straight Polyethylene Laminate Flashing Tape complying with the following:
 - a. Face Material composition: Polyethylene laminate
 - b. Face color: White
 - c. Adhesive composition: Butyl adhesive containing fire retardant additive
 - d. Thickness: 30 mils
 - e. Release liner: 1 piece siliconized paper
 - f. Dimension: 4 inch width
3. Accessories:
 - a. Sealing Tape:
 - 1) Material: Pressure sensitive, polypropylene substrate with acrylic based adhesive. Provides permanently elastic, nonsag, nontoxic, nonstaining tape, which is compatible with Air Barrier and Flexible Flashing system products.
 - b. Fasteners:
 - 1) Material: 1" diameter plastic cap, nail length (1", 1 1/2", 2") for wood frame construction, or 2" diameter plastic cap with 1 5/8" drill point self tapping screw for metal stud applications, designed to withstand designed loads.
4. Sealants: Refer to Division 07 Section 079200 "Sealants."
5. Provide primers and mastic by manufacturer, as required.

2.4 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Bituminous Paint: Acid and alkali-resistant type; black color; FS TT-C-494 or SSPC-Paint 12 solvent type, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.
- B. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

- C. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 07 Section "Sealants".
- D. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior and interior nonmoving joints, including riveted joints.
- E. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.
- F. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.

2.5 FABRICATION, GENERAL

- A. Sheet Metal Fabrication Standard: Fabricate metal flashing and sheet metal to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.
- B. Comply with details shown to fabricate metal flashing and sheet metal that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Form exposed sheet metal work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
- D. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- E. Expansion Provisions: Comply with SMACNA standards. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
- G. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.
- H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.
- I. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.
 - 1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application, but never less than thickness of metal being secured.
- J. Form gutters and downspouts of profiles and sizes indicated and as required to properly collect and remove water. Fabricate complete with required connection pieces.

1. Form sections square, true, and accurate in size, in maximum possible lengths and free of distortions and defects detrimental to appearance or performance hem exposed edges. Allow for expansion at joints. Miter gutter corners.

2.6 FABRICATION - FLASHINGS AND CAP FLASHINGS

- A. Form sections square true, and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- B. Form sections in maximum lengths. Make allowances for expansion at joints.
- C. Seams are to be standing lock or batten type except corners. Fabricate corners minimum 18 inches mitered, soldered, or welded, and sealed as one piece.
- D. Wipe and wash clean, soldered joints, to remove traces of flux immediately after soldering.
- E. Hem exposed edges of flashings on underside 1/2 inch.
- F. Backpaint flashings with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Comply with manufacturer's instructions and recommendations for handling and installation of flashing and sheet metal work.
- B. Performance: Coordinate the work with other work for the correct sequencing of items which make up the entire membrane or system of weatherproofing or waterproofing and rain drainage. It is required that the flashing and sheet metal work be permanently watertight, and not deteriorate in excess of manufacturer's published limitations.
- C. Examine substrates and conditions under which flashing and sheet metal are to be installed and verify that work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION – SHEET METAL

- A. General: Unless otherwise indicated, install metal flashing and sheet metal to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual". Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.
- B. Install exposed sheet metal work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install metal flashing and sheet metal to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

- D. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
 - 1. Use joint adhesive for nonmoving joints specified not to be soldered.
- E. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder. Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- F. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
- G. Counter-flash mechanical, electrical, and other items projecting through membrane roofing.
 - 1. Pipes and Conduit Penetrations:
 - a. Flash with lead sheet extending flanges 9" from wall or pipe.
 - b. Extend flashing up pipe and turn down inside pipe a minimum 2".
 - c. On tall pipe extend flashing a minimum of 9" up side of pipe and cover with galvanized malleable iron collar with draw band; seal top of collar against vent pipe.
 - d. Set flanges on top of sheet roofing and strip in with a 12" wide section of roofing.
- H. Roof-Drainage System: Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA's Manual or the item manufacturer, to drain roof in the most efficient manner. Coordinate roof-drain flashing installation with roof-drainage system installation. Spike type anchors will not be permitted. Coordinate flashing and sheet metal items for steep-sloped roofs with roofing installation.

3.3 INSTALLATION - WALL FLASHINGS

- A. Membrane Wall Flashing:
 - 1. Install at all windows, doors, and other locations as shown on Drawings in strict accordance with manufacturer's specifications to provide a watertight enclosure.
 - 2. Substrate must be smooth, clean, dry and free of voids, spalled areas, loose substrate, loose nails, other sharp protrusions or other matter that will hinder the adhesion or regularity of the flashing tape installation. Clean loose dust or dirt from surface wherever flashing tape is to be applied by wiping with a clean dry cloth or brush.
 - 3. Apply membrane over approved primer. Membrane wall flashings shall overlap one to two inches, as recommended by manufacturer. All membrane overlaps shall be firmly rolled immediately following installation to minimize bubbles caused by outgassing air vapor.
 - 4. Apply a bead of sealant along top edge of flashing membrane and along seams and cuts as required.
 - 5. Where thru-wall flashing terminates within the wall cavity, a stainless steel termination bar must be used to secure the top edge of the membrane flashing.
- B. Install window and door flashings AFTER installation of Air Infiltration Barrier as follows:
 - 1. Prepare Air Infiltration Barrier for window or door installation.

2. Make a modified "I-cut" in the Air Infiltration Barrier.
 3. Cut a flap above the rough opening to allow head flashing installation.
 4. Fold side and bottom flaps into rough opening and secure. Flip head flap up and temporarily secure.
 5. Cut Elasticized Flexible Flashing Tape at least 12" longer than width of rough opening sill.
 6. Remove first piece of release paper, align edge of sill flashing with inside edge of sill, and adhere into rough opening across sill and up jambs (minimum 6"). Sill flashing should not wrap onto interior surface of framing.
 7. Remove the second release paper.
 8. Fan Elasticized Flexible Flashing Tape at bottom corners onto face of wall.
 9. Firmly press sill flashing to insure full adhesion.
 10. Secure edges of bottom corners with approved sealing tape or mechanical fasteners.
 11. Apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do NOT apply sealant across sill.
 12. Install window or door in to opening.
 13. Remove release paper and install Straight Polyethylene Laminate Flashing Tape jamb flashings overlapping entire mounting flange of both jambs. Extend jamb flashings 6-inches above top of rough opening to below bottom of sill flashing.
 14. Remove release paper and install Straight Polyethylene Laminate Flashing Tape as head flashing overlapping entire mounting flange. Head flashing should extend beyond outside edges of both jamb flashings.
 15. Flip head flap down over the head flashing.
 16. Secure flap above window with approved sealing tape.
 17. Install Sealant (using backer rod if necessary) to seal rear of window/door frame to rough opening.
- C. Door Head Flashing:
1. Cut head flashing at least 12" longer than the arc length of Door Head.
 2. Remove both release papers and install conforming around top of door, covering entire mounting flange. Head flashing should overlap jamb flashings at least 6".
 3. To facilitate installation to door heads, remove short lengths of release papers, begin installation, and repeat to work flashing into position and complete installation.
 4. Secure outer edges of head flashing with approved sealing tape or mechanical fasteners.
 5. Secure flap above door head with approved sealing tape.
- D. Other Openings and Penetrations: Provide flashings for other openings as required to provide weathertight barrier. Install lapped components to direct water to exterior of building.

- E. End Dams: Extend flashing the full length of lintels and shelf angles and minimum of 4" into masonry each end. Extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4", and through the inner wythe to within 1/2" of the interior face of the wall in exposed work. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2". At heads and sills, turn up ends not less than 2" to form a pan. Extend flashing on exterior to 1/4 inch past wall surface. Do NOT cut flush with wall.

3.4 INSTALLATION - SOFFITS

- A. Install soffits and accessories in accordance with manufacturer's standard published details and installation instructions.
- B. Installation of materials specified within this Section shall be in accordance with the best practice, with all joint members true and plumb.
- C. Provide for expansion and contraction. Do not drive nail heads tight against nailing lock. Nail size shall be in accordance with the manufacturer's printed instruction.
- D. Provide sealant applications at all locations as recommended by the soffit manufacturer.

3.5 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- B. Provide final protection and maintain conditions that ensure flashing and sheet metal work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION 07 62 00 (07620)

SECTION 07 84 13 – PENETRATION FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Penetrations Through Fire-Resistance-Rated Floor, Wall And Roof Construction
 - 2. Joints at Walls, Floors, And Roof Assemblies
- B. Related Sections:
 - 1. Refer to Divisions 21 through 28 Sections for additional requirements.

1.2 REFERENCES

- A. [ASTM International](#) Publications:
 - 1. E119 "Standard Test Methods for Fire Tests of Building Construction and Materials"
 - 2. E814 "Standard Test Method for Fire Tests of Through-Penetration Fire Stops"
 - 3. E1966, "Standard Test Method for Fire Resistive Joint Systems"
 - 4. E2174, "Standard Practice for On-site Inspection of Installed Fire Stops"
 - 5. E2307, "Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus"
- B. [Code of Federal Regulations \(CFR\)](#) Publications:
 - 1. 40 [CFR](#) 763, Subpart F, Appendix A, Section 1 "Polarized Light Microscopy"
- C. [Underwriter's Laboratories, Inc. \(UL\)](#) Standards
 - 1. "Fire Resistance Directory"
 - 2. 1479 "Fire Tests of Through-Penetration Firestops"
 - 3. 2079 "Tests for Fire Resistance of Building Joint Systems"
- D. [Warnock Hersey, ETL SEMKO division of Intertek \(WHI\)](#) Publications:
 - 1. "Certification Listings"
- E. [Omega Point Laboratories, Inc. ETL SEMKO division of Intertek](#) Publications:
 - 1. "Directory of Listed Building Products, Materials and Assemblies"

1.3 SYSTEM DESCRIPTION

- A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases, including:
 - 1. Penetrations through fire-resistance-rated floor and roof construction, including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.
 - 2. Penetrations through fire-resistance-rated walls and partitions, including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

3. Joints at walls, floors, top of wall (head of wall) at floor and roof assemblies, edge of floor slabs at exterior walls, and openings around structural members which penetrate floor and wall assemblies.

B. Performance Requirements:

1. F-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per [ASTM E814](#), but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.
 2. T-Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings, in addition to F ratings, as determined per [ASTM E814](#), where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-rated assemblies are required where the following conditions exist:
 - a. Where firestop systems protect penetrations located outside of wall cavities.
 - b. Where firestop systems protect penetrations located outside fire-resistive shaft enclosures.
 - c. Where firestop systems protect penetrations located in construction containing doors required to have a temperature-rise rating.
 - d. Where firestop systems protect penetrating items larger than a 4-inch-diameter nominal pipe or 16 sq. in. in overall cross-sectional area.
 3. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per [ASTM E119](#), but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.
 4. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
 - a. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - b. For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.
- C. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
1. Provide product data for each type of product specified.
 - a. Certification by firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants.
 2. Provide product certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.

3. Provide product test reports from, and based on tests performed by, a qualified testing and inspecting agency evidencing compliance of firestopping with requirements based on comprehensive testing of current products.
 4. Provide manufacturer's engineering judgment identification number and drawing details when there is no UL, Warnock Hersey or OPL system available for an application. Engineering judgment must include both project name and the contractor's name who will install firestop system as described in judgment drawing.
- B. Information within construction documents referring to specific design designations of through-penetration firestop systems is intended to establish requirements for performance based on conditions that are expected to exist during installation. Any changes in conditions and designated systems require the Architect's prior approval. Submit documentation showing that the performance of proposed substitutions equals or exceeds that of the systems they would replace and are acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain through-penetration firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the "System Performance Requirements" article:
1. Firestopping tests shall be performed by a qualified testing and inspecting agency.
 - a. Qualified testing and inspecting agencies are:
 - 1) [UL](#)
 - 2) [Warnock Hersey](#).
 - 3) Or another agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction.
 2. Through-penetration firestop systems are identical to those tested per [ASTM](#) E814 under conditions where positive furnace pressure differential of at least 0.01 inch of water is maintained at a distance of 0.78 inch below the fill materials surrounding the penetrating items in the test assembly. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by [UL](#) in their "Fire Resistance Directory", by [Warnock Hersey](#) or by another qualified testing and inspecting agency.
- C. Engineering Judgements:
1. For those firestop applications that exist for which no UL tested system is available through a manufacturer, an engineering judgment derived from similar UL system designs or other tests shall be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.

- D. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 [CFR](#) Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy".
- E. Coordinate Work: Coordinate construction of openings and penetrating items to ensure that designated through-penetration and joint firestop systems are installed per specified requirements.
- F. A manufacturer's direct representative shall be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures per manufacturer's written recommendations.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver firestopping products to project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT/SITE CONDITIONS

- A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilation: Ventilate firestopping per firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

PART 2 PRODUCTS

2.1 FIRESTOPPING, GENERAL

- A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
 - 1. For penetrations involving CPVC piping, provide through-penetration firestop systems which include materials that have been tested to be compatible with CPVC piping.
- B. Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with "System Performance Requirements" article in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include, but are not limited to, the following items:
 - 1. Permanent Forming/Damming/Backing Materials, Including the Following:
 - a. Semirefractory Fiber (mineral wool) Insulation
 - b. Ceramic Fiber
 - c. Sealants Used in Combination with Other Forming/Damming Materials to Prevent Leakage of Fill Materials in Liquid State

- d. Fire-rated Formboard
- 2. Temporary Forming materials
- 3. Substrate Primers
- 4. Collars
- 5. Steel Sleeves
- C. Under normal environmental conditions, all material used shall be non-corrosive to metal and compatible with synthetic cable jackets.
- D. Provide all miscellaneous items required to attach materials as specified and shown on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
 - 1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
 - 2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form release agents from concrete.
- B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond. Do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Comply with the "System Performance Requirements" article in Part 1 and the firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.

- B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:
 - 1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 CLEANING

- A. Clean-off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.
- B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.
- C. Promptly remove any excess materials from any exposed finish surfaces. Repair floors, walls, or other surfaces which have been stained, marred, or otherwise damaged during installation of fire barrier materials.

END OF SECTION 07 84 00 (07840)

SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Clean and Prepare Joint Surfaces
2. Sealant and Backing Materials including primers, backer rods, bond breakers and accessories.

1.2 REFERENCES

A. [ASTM International](#) Publications:

1. C834 "Standard Specification for Latex Sealants"
2. C920 "Standard Specification for Elastomeric Joint Sealants"
3. C1193 "Standard Guide for Use of Joint Sealants"
4. C1248 "Standard Test Method for Staining of Porous Substrate by Joint Sealants"

B. [Code of Federal Regulations \(CFR\)](#) Publications:

1. 21 CFR, Part 177 "Indirect Food Additives: Polymers"

C. [Federal Specifications \(FS\)](#) Publications:

1. TT-S-1543B Sealing Compound; Silicone Rubber Base (For Caulking, Sealing)

D. [Underwriter's Laboratories, Inc. \(UL\)](#) Standards

1. "Fire Resistance Directory"

E. [Warnock Hersey, ETL SEMKO division of Intertek \(WHI\)](#) Publications:

1. "Certification Listings"

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:

1. Product data including samples and manufacturer's surface preparation and installation instructions.
 - a. List of primers recommended for each application.
2. Submit samples of each color required for each type of joint sealer exposed to view in duplicate.
3. Certifications: Indicate compliance with standards specified in duplicate.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

- C. All materials shall be verified by this Contractor to be compatible with adjacent materials.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees F. and less than 100 degrees F.
 - 2. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

1.7 EXTRA MATERIALS

- A. Furnish extra sealant materials from same production run as the materials applied in the quantities described below. Package materials in unopened, factory-sealed containers with labels describing contents.
 - 1. Quantity: Furnish one unused tube of each type and color of exterior sealant applied.

PART 2 PRODUCTS

2.1 SEALANTS, GENERAL

- A. Colors: As shown on the Drawings or if not shown, match sealant material to colors of adjacent materials, as approved by [Architect] [Owner's Representative], unless indicated otherwise.
- B. Elastomeric Sealant Standard: [ASTM](#) C920 and other requirements indicated for each liquid-applied chemically curing sealant, including those referencing [ASTM](#) C920 classifications for type, grade, class, and uses.
- C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to [ASTM](#) C1248 and have not stained porous joint substrates indicated for Project.
- D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.2 JOINT SEALANTS

- A. Sanitary Sealant, Interior Use: One component silicone rubber sealant.
 - 1. [ASTM](#) C920, Type S, Grade NS, Class 25, and FS-TT-S-1543B, Class A, Use NT.
 - 2. Provide acid cure, nonporous bond type, mildew resistant silicone rubber where both joint faces are metal, glass, plastic, tile, or other non-porous material.

- B. Interior Joints Not Subject to Movement: One part, gun grade, acrylic latex.
 - 1. [ASTM](#) C834, Type OP, Grade NF, with 10 year life expectancy.
- C. Interior Joints subject to Movement: Single-component, Nonsag, Urethane Joint Sealant
 - 1. ASTM C 920, Type S, Grade NS, Class 25, for Use NT and FS-TT-S230 with 20-year life expectancy.
 - 2. Colors: Match sealant material to colors of adjacent materials, as selected by Architect from manufacturer's standard colors.
- D. Exterior joints greater than 1/2" [(except E.I.F.S. areas)]: Multicomponent, Nonsag, Urethane Joint Sealant:
 - 1. [ASTM](#) C920, Type M, Grade NS, Class 50, for Use NT. With 20 year life expectancy.
 - 2. Colors: Match sealant material to colors of adjacent materials, as selected by [Architect] [Owner's Representative] from manufacturer's standard colors.
- E. Exterior Joints at E.I.F.S. Areas: Provide sealant materials known to be compatible with the exterior insulation finish system (E.I.F.S.) specified in Section 07 24 19. Product utilized shall be verified by this Contractor for approval with E.I.F.S. manufacturer utilized on this Project.
 - 1. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.
- F. Sealant Materials - Glazing: composition shall be a silicone base, single component, solvent curing, capable of withstanding movement of up to 50 percent of joint width and shore a hardness of 26.
 - 1. [ASTM](#) C920, TTS-S-001543A and TT-S-00230C (COM-NBS).

2.3 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Filler Backer Rod: [ASTM](#) D1056; D1565; round, closed cell polyethylene, non-gassing rod sized to produce 25% compression when installed in joint.
- D. Bond Breaker Tape:
 - a.
- E. Cleaners for Nonporous Surfaces: Provide nonstaining, chemical cleaners of type which are acceptable to manufacturers of sealants and sealant backing materials, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.
 - 1. Provide cleaner conditioner required for glass and glazed surfaces as recommended by sealant manufacturer.
- F. Masking Tape: Provide nonstaining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealers, with Installer present, for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Do not proceed with installation of joint sealers until unsatisfactory conditions have been corrected. Beginning of Installation means acceptance of all existing conditions making this Contractor responsible for correcting all unsatisfactory and defective work encountered at his expense.

3.2 PREPARATION

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

3.3 INSTALLATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply. Surfaces and air temperature shall be greater than 30 degrees F and less than 100 degrees F.
- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on reconstruction 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.
 - 1. Ensure that primer fully covers surfaces to which sealant is to adhere.
 - 2. Apply with bristle brush. Do not flood surfaces.
 - 3. Allow primer to dry 30 minutes minimum or as recommended by manufacturer prior to application of backing rod and sealant.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond breaker tape between sealants and joint fillers, compression seals, or back of joints where adhesion of sealant to surfaces at back of joints would result in sealant failure. Bond breaker must be used in all conditions where three-sided adhesion may be possible.
- E. Install sealants by proven techniques to 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 provided for each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
 4. Joint Size:
 - a. Depth of joint shall not exceed width of joint.
 - b. Minimum depth: $\frac{1}{4}$ "
 - c. Maximum depth: $\frac{1}{2}$ "
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealants from surfaces adjacent to joint.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - a. Provide concave joint configuration per Figure 5A in [ASTM](#) C1193, unless otherwise indicated.
 - b. Provide flush joint configuration, per Figure 5B in [ASTM](#) C1193, where indicated.
 - c. Provide recessed joint configuration, per Figure 5C in [ASTM](#) C1193, of recess depth and at locations indicated.
 - 1) Use masking tape to protect adjacent surfaces of recessed tooled joints.
 - 2) All joints shall be free of air pockets, foreign embedded matter, ridges, and sags.
- 3.4 CURE:
- A. Cure sealant in compliance with manufacturer's instructions and recommendations to obtain high, early bond strength, internal cohesion strength and surface durability.
- 3.5 CLEANING:
- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur. Remove masking material immediately following sealant application.

3.6 PROTECTION:

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

END OF SECTION 07 92 00 (07920)

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior Hollow Metal Doors and Frames
2. Exterior Hollow Metal Doors and Frames

1.2 REFERENCES

A. [ASTM International \(ASTM\)](#) Publications:

1. A153 "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"
2. A568 "Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for"
3. A591 "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hop-Dip Process"
4. A653 "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process"
5. A924 "Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process"
6. A1008 "Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability"
7. A1011 "Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability"
8. C143/C 143M
9. C476 "Standard Specification for Grout for Masonry"
10. C665 "Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing"
11. E90 "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements"
12. E136 "Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C"
13. E2074 "Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies"

B. [American National Standards Institute \(ANSI\)](#) Publications:

1. ANSI/SDI A250.3 "Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames"
2. ANSI/SDI A250.4 "Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings"
3. ANSI/SDI A250.6 "Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames"

4. ANSI/SDI A250.8 - SDI-100 "Recommended Specifications for Standard Steel Doors and Frames"
 5. ANSI/SDI A250.10 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames"
 6. ANSI/SDI A250.11 "Recommended Erection Instructions for Steel Frames (Formerly SDI-105)"
- C. [ANSI/DHI Publications](#):
1. DHI A115.1G "Installation Guide for Doors and Hardware"
- D. Commercial Standards
1. CS-242-62
- E. [National Fire Protection Association \(NFPA\)](#) Publications:
1. NFPA 80 "Standard for Fire Doors and Windows"
 2. NFPA 105 "Hot Smoke Test"
 3. NFPA 252 "Standard Methods of Fire Tests of Door Assemblies"
- F. [Steel Door Institute \(SDI\)](#) Publications:
1. SDI 105 through 128
- G. [Underwriter's Laboratories, Inc. \(UL\)](#) Standards
1. UL Building Materials Directory; Underwriters Laboratories Inc.
 2. UL 10B "Standard for Fire Tests of Door Assemblies"
 3. UL 10C "Positive Pressure Fire Tests of Door Assemblies"
 4. UL 1784 "Air Leakage Tests of Door Assemblies"
 5. Procedure No. R-3791
 6. Procedure No. R-3821
- H. [Warnock Hersey, ETL SEMKO division of Intertek \(WHI\)](#) Publications:
1. "Certification Listings"
- 1.3 DEFINITIONS
- A. Steel Sheet Thicknesses: Thickness dimensions, including those referenced in [ANSI](#) A250.8, are minimums as defined in referenced [ASTM](#) standards for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets.
- 1.4 SUBMITTALS
- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
1. Product Data: Provide for each type of steel door and frame specified the following:
 - a. Construction details, material descriptions, and core descriptions.
 - b. Label compliance, fire-resistance and temperature-rise ratings
 - c. Finishes

- d. Manufacturer's installation instructions.
2. Shop Drawings: Indicate pertinent dimensioning, construction, component connections and locations and the following:
 - a. Elevations of each door design; locations and details of anchorages, accessories, joints, and connections; details of doors including vertical and horizontal edge details.
 - b. Details of each different wall opening condition.
 - c. Frame details for each frame type including dimensioned profiles, details and locations of reinforcement and preparations for hardware.
 - d. Hardware locations and installation details
 - e. Coordination of glazing frames and stops with glass and glazing requirements.
3. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings.
 - a. Indicate coordination of glazing frames and stops with glass and glazing requirements.

1.5 QUALITY ASSURANCE

- A. Hollow metal doors and frames shall be fabricated in accordance with standards and specifications established by Steel Door Institute, complying with [ANSI](#) A250.8-1998 (SDI-100) "Recommended Specifications for Standard Steel Doors and Frames" and as specified.
- B. Single Source Responsibility for Doors and Frames: To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each type of door and frame indicated.
- C. Acoustical qualities: Doors shall have a minimum sound transmission classification of 29 as tested under [ASTM](#) E90 61T.
- D. Installer Qualifications: Installer experienced in performing work of this section who has specialized in the installation of work similar to that required for this project.
 1. Certificate: When requested, submit certificate indicating qualification.
- E. Inspection: General Contractor shall provide in writing to [\[Architect\]](#) [\[Owner's Representative\]](#) an inspection of all steel doors and frames for conformance to specifications. Inspection shall include checking for fit tolerance plumb and level as well as proper hardware and operation.

1.6 REGULATORY REQUIREMENTS

- A. Fire-Rated Door Assemblies: Units that comply with [NFPA](#) 80 are identical to door and frame assemblies tested for fire-test-response characteristics per [ASTM](#) E2074, and are labeled and listed by [UL](#), [Warnock Hersey](#), or another testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated. Test pressure shall be tested in accordance with [NFPA](#) 252, or [UL](#) 10C to comply with local code requirements.
- B. Opening assemblies shall meet the requirements of [NFPA](#) 105 Hot Smoke Test.
- C. All stairwell doors and other doors as may be shown on the Drawings shall comply with the temperature-rise rating of 450 degrees F. maximum in 30 minutes of fire exposure.

- D. Comply with the requirements of the International Building Code with testing in accordance with [UL 10C](#) for positive pressure door test.
 - 1. Test Pressure: After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill.
 - 2. Doors shall be labeled to certify compliance.
 - 3. Provide installation instructions attached to each door in a manner that assures availability to the installer and building official.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work cardboard wrapped or crated to provide protection during transit and job storage.
 - 1. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
 - 2. Deliver welded frames with two removable spreader bars across bottom of frames.
- B. Label each item, before shipping, with metal or plastic tags to show their location, size, door swing, and other pertinent information.
- C. Inspect doors and frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to [\[Owner's Representative\]](#). Remove and replace damaged items that cannot be repaired as directed.
- D. Store doors and frames at building site under cover, in an upright position:
 - 1. Place units on minimum 4-inch-high wood blocking in a manner to prevent rust and damage. Provide minimum 1/4-inch spaces between stacked doors to permit air circulation.
 - 2. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

- A. Coordinate installation of anchorages for standard steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Hot-Rolled Steel Sheets: [ASTM](#) A1011 and A568, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

- B. Cold-Rolled Steel Sheets [ASTM](#) A1008 and A568, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
- E. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to [ASTM](#) A153.
- F. Grout at Masonry Openings: [ASTM](#) C476, except with a maximum slump of 4 inches, as measured according to [ASTM](#) C143.
- G. Glazing: Comply with requirements in Section 08 80 00 Glazing.

2.2 HOLLOW METAL FRAMES

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with [ANSI](#)/SDI A250.8.
- B. Fabricate steel frame units to comply with [ANSI](#)/SDI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site. Conceal fastenings, unless otherwise indicated.
- C. Location and Type: All metal frames for doors shall be formed of steel to sizes and shapes indicated. Frames shall be fabricated with continuously welded corners unit type construction at joints. Frames shall be furnished with Underwriter's Laboratories label, as required, at the place of manufacturer.
- D. Workmanship and Design: The finished work shall be strong and rigid, neat in appearance, and free from defects. Fabricate members straight and true with corner joints well-formed, in true alignment and fastenings concealed where practicable.
- E. Forming Corner Joints: Joints for welded-type frames shall be mitered and continuously arc-welded for full depth and width of frame and trim. All contact edges shall be closed tight and all welds on exposed surfaces dressed smooth and flush.
- F. Type and Gauges of Metal: Metal for frames shall be cold-rolled or hot-rolled, pickled and oiled, steel sheets with clean, smooth surfaces. Except where other gauges are indicated or specified, frames shall be fabricated from steel, not lighter than the following U.S. Standard gauges:
 - 1. Interior Frames of 16-gauge thick steel sheet for:
 - a. Level 2 steel doors.
 - b. Wood doors, unless otherwise indicated.
 - 2. Exterior Frames of 16-gauge (0.053-inch) thick steel sheet for:
 - a. Level 2 steel doors.
 - b. Level 3 steel doors.

3. Exterior frames shall be fabricated from metallic-coated steel sheet..

G. Drywall Frames:

1. Drywall frames shall be the same as flush frames except:

- a. Frames shall be formed with double return backbends to prevent cutting into drywall surface. Frames shall be knocked down, designed to be securely installed in the rough opening after wallboard is applied. Mitered corners shall be reinforced with a wedge lock corner clip to provide a firm interlock of jambs to head.
- b. Each jamb shall have an adjustable anchor located 4" from the top of the door opening to hold frame in rigid alignment. Frames shall have a welded-in base anchor attaching plate in each jamb for field installation of loose base anchors or frames shall have two (2) dimpled holes in each jamb for anchoring base of frame with screws.

- H. Wall Anchors: Provide metal anchors of shapes and sizes required for the adjoining type of wall construction. Locate anchors on jambs near the top and bottom of each frame and at intermediate points not over 24 inches apart. Galvanized anchors for exterior frames.

1. Anchor types shall be varied to provide positive fastening to adjacent construction.
2. Provide UL approved anchors for UL labeled frames. Anchorage of UL label frames shall conform to printed UL test report for door frame manufactured.

- I. Plaster Guards: Provide 0.016-inch-thick, steel sheet plaster guards or mortar boxes to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation. Required at all door strikes.

- J. Floor Anchors: Provide floor clips of not less than 16-gauge steel and fasten to bottom of each jamb member for anchoring frame to floor construction. Clips shall be adjustable and drilled for 3/8" diameter anchor bolts.

- K. Shipment: For welded type frames, provide temporary steel spreaders fastened across bottom of frames. Where construction will permit concealment, leave spreaders in place after installation. Otherwise, remove spreaders after frames are set and anchored. In place of spreaders, frames may be strapped together in pairs with heads inverted for bracing during shipment. Before shipping, label each frame with metal or plastic tapes to show their location, size, door swing, and other pertinent information.

2.3 HOLLOW METAL DOORS

A. General:

1. Fabricate steel door units to comply with ANSI/SDI A250.8. and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.

- B. Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical-endurance level:

1. Flush Door:

- a. Thickness: 1-3/4"
- b. Level 3 and Physical Performance Level B (Extra Heavy Duty), Model 2 (Seamless).

2. Exterior doors shall be fabricated as thermal insulating door and frame assemblies and tested in accordance with [ASTM C236](#) or [ASTM C976](#) on fully operable door assemblies.
 - a. Provide thermal-rated assemblies with U-factor of 0.24 or better.
 3. Face sheets shall be fabricated from metallic-coated steel sheet
 4. All exterior swing-out doors shall have the top and bottoms closed to eliminate moisture penetration. Door tops shall not have holes or openings. Top caps are permitted.
- C. Interior Doors: Provide doors complying with requirements indicated below by referencing [ANSI/SDI A250.8](#) for level and model and [ANSI/SDI A250.4](#) for physical-endurance level.
1. Interior Flush Door:
 - a. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).
 - b. Thickness: 1-3/4"
 - c. Cores: Per [ANSI/SDI A250.8](#)
 - d. Doors shall be reinforced, stiffened, sound deadened and insulated with impregnated Kraft honeycomb core completely filling the inside of the doors and laminated to inside faces of both panels using contact adhesive applied to both panels and honeycomb core.
 2. Interior Temperature Rise Doors
 - a. Temperature rise doors shall be the same as flush door construction except core material shall be designed to produce the 450 degree temperature rise rating.
 - b. Cores: Per [ANSI/SDI A250.8](#).
 - c. Mineral-Fiber Board: For labeled doors if a temperature-rise limit is required.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Door Louvers:
1. Furnish and install louvers for interior doors, where indicated on the drawings, that comply with [SDI 111C](#), with blades or baffles formed of 0.020-inch thick, cold-rolled steel sheet set into 0.032-inch thick steel frame.
 - a. Provide stationary sight-proof louvers with inverted V-Shaped or Y-Shaped blades of sizes and locations as shown on the Drawings.
 - b. Provide Fire-Rated Automatic Louvers of sizes and locations as shown on the Drawings at fire-rated openings.
 - 1) Louvers to be constructed with movable blades closed by actuating fusible links and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by the same testing and inspecting agency that established fire-resistance rating of door assembly.

2.4 FABRICATION

- A. Door and Frame Fabrication:
- B. Fabricate doors and frames in accordance with [ANSI/SDI A250.8](#).
- C. Workmanship: The finished work shall be rigid, neat in appearance, and free from defects; form molding members straight and true with joints coped or mitered, well formed and in true alignment. All welded joints on exposed surfaces shall be dressed smooth so they are invisible after finishing.
- D. Door Sizes and Clearances: Doors shall be of type, sizes, and design indicated. The clearances for doors shall be 1/8" at jambs and heads and 3/4" at bottom, unless indicated or specified otherwise. Clearances at meeting edges of pairs of doors shall be 1/4" (1/8" on fire doors).
 - 1. Clearances for Fire-Rated Doors: As required by [ANSI/NFPA 80](#).
- E. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- F. Provisions for Hardware: Mortise, reinforce, drill, and tap doors at factory to receive all mortise-type hardware. Provide reinforcing only for doors to receive surface-applied hardware, except push plates and kick plates; drilling and tapping for surface-applied hardware will be done in the field. Provide metal reinforcing plates for surface-applied hardware as required. The gauges of metal for reinforcing plates shall comply with manufacturer's recommendation for the type of hardware used and the size and thickness of doors, provided that the minimum requirements are as follows:
 - 1. Hinge Reinforcement - 3/16 Inch
 - 2. Strike Reinforcement - 11 Gauge
 - 3. Closers and Bracket Reinforcement - 12 Gauge
 - 4. Mortise Covers - 26 Gauge
- G. The gauges used shall not be lighter than those required by Commercial Standard CS
- H. Welding of hinges to frames will not be permitted. Frames shall be mortised, reinforced, drilled, and tapped to templates to receive all mortised hardware. Provide cover boxes in back of all hardware cut-outs. Lock strikes shall be set out and adjusted to provide clearance for silencers.
 - 1. Provide preparation for rubber silencers on interior room door frames; three per strike jamb at single doors.
 - 2. Provide concealed metal reinforcements for hardware as required. The gauges of metal for reinforcement shall be in accordance with the manufacturer's recommendations for the type of hardware and the thickness and width of doors to be hung in the frame, provided that the gauges used are not lighter than those required by Commercial Standard CS-242-62.
 - 3. All frames shall have a security anchor system installed on strike jamb
 - a. Provide safeguard at strike to prevent entry by prying.
- I. Glazing Preparation:
 - 1. Doors indicated to have glass shall have non-removable glazing stops on the exterior sides of the openings and removable or snap-on type stops on the inside of the openings.

2. Provide manufacturer's vision lites of sizes and locations as shown on Drawings, recessed into the door face similar to "Dezigner Trim" by Steelcraft.
3. Stops shall be [UL](#) approved for [UL](#) labeled doors.
- J. Doors with labels shall carry Underwriters label on the door and on the frame. They shall be constructed to meet Procedure No. R-3791 and R-3821, as listed by [Underwriters Laboratories](#).

2.5 FINISHES

- A. General: Comply with [NAAMM](#)'s "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 1. Finish steel doors and frames after assembly.
- B. Factory Prime Coating for Field Painted Finish: Unless specified otherwise, provide manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with [ANSI](#)/SDI A250.10 for acceptance criteria.
 1. Clean and chemically treat metal surfaces to assure maximum paint adherence. Follow with a dip or spray coat of lead-free, rust-inhibitive metallic oxide, zinc chromate, or synthetic resin primer on all exposed surfaces. Finished surfaces shall be smooth and free from irregularities and rough spots.

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 standard steel doors and frames.
 1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.

3.2 GENERAL

- A. Install hollow metal doors and frames and their accessories in strict accordance with these Specifications and manufacturer's data.
- B. Hardware: For installation see Section 08 71 00, "Door Hardware".

3.3 PLACING FRAMES

- A. Comply with the provisions of the ["Steel Door Institute"](#) 105, unless otherwise indicated.
- B. Set frames accurately in position, plumbed, aligned, and braced until permanent anchors are set.
 1. Except for frames located in existing walls or partitions, place frames before construction of enclosing walls and ceilings.
- C. Frame Insulation: Install insulation in frames of gypsum board partitions. Cut insulation to full width of frame throat and friction fit within the jamb and head. Pack solid around perimeter of the frame.
- D. Anchor bottom of frames to floors with expansion bolts, or with power fasteners. Build wall anchors into walls or secure to adjoining construction as indicated or specified. Where frames require ceiling struts or other structural overhead bracing, they shall be anchored securely to ceiling or structural framing above as indicated and specified.

1. In masonry construction, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
 2. In metal-stud partitions, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Attach wall anchors to studs with screws.
 3. For openings 90 inches or more in height, install an additional anchor at hinge and strike jambs.
- E. Install fire-rated frames in accordance with [NFPA](#) Standard No. 80.

3.4 DOOR INSTALLATION

- A. Door Installation: Comply with [ANSI](#) A250.8. Fit hollow metal doors accurately in their respective frames within clearances specified in [ANSI](#) A250.8. Shim as necessary to comply with [SDI](#) 122 and [ANSI/DHI](#) A115.1G .
- B. Place fire-rated doors with clearances as specified in [NFPA](#) Standard No. 80.
- C. Smoke-Control Doors: Install to comply with [NFPA](#) 105.

3.5 ADJUSTMENT

- A. Check and re-adjust operating finish hardware items in hollow metal work just prior to final inspection.
- B. Remove and replace defective work including doors or frames which are warped, bowed, or otherwise damaged.
- C. Finished Doors: Refinish or replace doors damaged during installation.
- D. Protect doors as recommended by door manufacturer to ensure that doors will be without damage or deterioration at time of Substantial Completion.

3.6 TOUCH-UP

- A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.
- B. Repairs: Fill surface depressions with metallic paste filler, allow to cure, and sand flush for invisible joint with adjacent metal surfaces. Sand rust areas and apply touch-up paint using air drying paints compatible with shop finish. Damaged doors or frames that cannot be repaired shall be replaced.

3.7 CLEANING:

- A. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.
- B. Upon completion, metal surfaces of doors and frames that are completely factory finished shall be thoroughly cleaned and touched-up as recommended by the door manufacturer.

END OF SECTION 08 11 13 (08110)

SECTION 08 14 16 – FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

1. Types of doors required include the following:
 - a. Solid Core Flush Wood Doors
 - 1) Pre-Assembled (Pre-Hung) Optional

1.2 REFERENCES

- A. [Window and Door Manufacturers Association \(WDMA\)](#) Publications:
 1. I.S.1-A "Architectural Wood Flush Doors"
 2. I.S.6, "Industry Standard for Wood Stile and Rail Doors"
- B. [Architectural Woodwork Institute \(AWI\)](#) Publications:
 1. "Architectural Woodwork Quality Standards"
- C. [American National Standards Institute \(ANSI\)](#) Publications:
 1. ANSI/AHA A135.4 "Basic Hardboard"
 2. ANSI 208.1 "Standards for the Performance of Particleboard"
 3. ANSI Z97.1 "Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings"
- D. [ASTM International \(ASTM\)](#) Publications:
 1. C920 "Standard Specification for Elastomeric Joint Sealants"
 2. C1036 "Standard Specification for Flat Glass"
- E. [Door and Hardware Institute \(DHI\)](#) Publications:
 1. DHI-WDHS-3 "Recommended Hardware Locations for Wood Flush Doors"
 2. DHI A115 "Steel Door Preparation Standards"
- F. [National Fire Protection Association \(NFPA\)](#) Publications:
 1. NFPA 80 "Standard for Fire Doors, Fire Windows"
- G. [Underwriter's Laboratories, Inc. \(UL\)](#) Standards
 1. UL 10B "Standard for Fire Tests of Door Assemblies"
 2. UL 10C "Positive Pressure Fire Tests of Door Assemblies"

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 1. Product Data: Door manufacturer's technical data for each type of door to include the following:
 - a. Details of core and edge construction, trim for openings and louvers, [\[glazing\]](#).
 - b. Factory-finishing specifications.

2. Shop Drawings: Submit Shop Drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for factory finishing and other pertinent data.
 - a. Submittals shall use the same designations for door and hardware numbers as shown on the Drawings.

1.4 QUALITY ASSURANCE

- A. Quality Standards: Comply with the following standards:
 1. [WDMA](#) Quality Standard: I.S.1-A "Architectural Wood Flush Doors", and I.S.6, "Industry Standard for Wood Stile and Rail Doors" of [Window and Door Manufacturers Association \(WDMA\)](#).
 2. [AWI](#) Quality Standard: "Architectural Woodwork Quality Standards", including Section 1300 "Architectural Flush Doors", and Section 100-S-3 "Moisture Content", of [Architectural Woodwork Institute \(AWI\)](#) for grade of door, core construction, finish and other requirements exceeding those of [WDMA](#) quality standard.
- B. Sound Transmission Class: All entrance doors from interior corridors, together with their perimeter seals shall have a minimum Sound Transmission Class (STC) of [26].
- C. Safety Glass: Provide products complying with [ANSI](#) Z97.1 and testing requirements of 16 [CFR](#), Part 1201, for Category II materials, unless those of Category I are expressly indicated and permitted.
- D. Fire-Rated Wood Doors: Provide wood doors that comply with [NFPA](#) 80, are identical in materials and construction to units tested in door and frame assemblies per [ASTM](#) E152, and which are labeled and listed for ratings indicated by [Underwriters Laboratory \(UL\)](#), [Warnock Hersey](#), [ETL SEMKO division of Intertek \(WHI\)](#), or other testing and inspection agency acceptable to authorities having jurisdiction.
 1. Provide rated stiles on fire rated doors.
 2. Comply with the requirements of the International Building Code with testing in accordance with [UL](#) 10C for positive pressure door test.
 - a. Test Pressure: After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill.
 - b. Doors shall be labeled to certify compliance.
 - c. Provide installation instructions attached to each door in a manner that assures availability to the installer and building official.
- E. Manufacturer: Obtain doors from one source.
- F. Inspection: General Contractor shall provide in writing to [\[Architect\]](#), an inspection of all doors and frames for conformance to specifications. Inspection shall include checking for fit tolerance, plumb and level, as well as proper hardware and operation.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standards and recommendations of [WDMA](#) pamphlet "How to Store, Handle, Finish, Install, and Maintain Wood Doors", as well as with manufacturer's instructions.
 - 1. Protect doors during transit, storage and handling to prevent damage, soiling and deterioration.
 - 2. Individually Package doors in vented poly bags with identifying marks prior to shipment. Doors shall not be removed from bags until ready to hang. After hanging, bags shall be placed over doors to provide protection until area in which doors are hung is free of construction traffic.
 - 3. Store doors off the floor at least 3" in an area that is not susceptible to standing water or high moisture. Store doors in an upright position with spacers or corner caps separating each door.
 - 4. Identify each door with individual opening numbers which correlate with designation system used on Shop Drawings for door, frames, and hardware, using temporary, removable or concealed markings.

1.6 PROJECT CONDITIONS

- A. Do not deliver or install doors until building is enclosed, wet work is complete, and conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during remainder of construction period to comply with the following requirements applicable to Project's geographical location:
 - 1. Referenced [AWI](#) quality standard including Section 100-S-11, "Relative Humidity and Moisture Content".

1.7 SPECIAL WARRANTY

- A. General: Warranties shall be in addition to and run concurrent with, and not be a limitation of, other rights the Owner may have under the Contract Documents.
- B. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form signed by manufacturer, Installer and General Contractor, agreeing to repair or replace defective doors that have warped (bow, cup or twist) more than 1/4 inch in a 42" x 84" section, or that show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3 inch span, or do not conform to tolerance limitations of referenced quality standards.
 - 1. Warranty shall also include reinstallation and finishing that may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.
 - 2. Warranty shall be in effect during the following period after date of Substantial Completion:
 - a. Solid-Core Interior Doors: Life of installation.
- C. Contractor's Responsibilities: Replace or refinish doors where Contractor's work contributed to rejection or to voiding of manufacturer's Warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Qualified Manufacturers:

1. Mohawk Flush Doors, a Masonite Company.

2.2 INTERIOR FLUSH WOOD DOORS

A. Solid Core Doors for Opaque Finish: Comply with the following requirements:

1. [AWI](#) Grade: Custom
2. Faces: [\[High Pressure Laminate\]](#)
 - a. Apply high pressure overlay directly to high-density hardboard crossbands.
3. Core: Solid
4. Thickness: 1-3/8"
5. Factory seal top and bottom rails.
6. Blocking: Provide either hardwood or Structural Composite Lumber (SCL) wood blocking in particleboard-core doors as follows:
 - a. Top Rail (No Closer): Minimum 1-1/8 inch.
 - b. Top Rail (Closer): Minimum 5-inch with remaining after installation. Verify with closer manufacturer.
 - c. Bottom Rail: Minimum 1-1/8 inch after undercut; 5-inch bottom-rail in doors indicated to have kick, mop, or armor plates.
7. Finish: Factory Primed for Field Finish. Color as shown in [\[Hampton Brand Standards Interior Finish Specifications\]](#).

B. Fire-Rated Solid Core Doors: Comply with the following requirements.

1. Faces and [AWI](#) Grade: Provide faces and grade to match non-rated doors in same area of building, unless otherwise indicated.
 - a. Construction: Manufacturer's core construction as required to provide fire-resistance rating indicated.
2. Blocking: Provide either hardwood or structural composite lumber wood blocking in particleboard-core doors or as required to meet specified fire rating and as follows:
 - a. Top Rail (No Closer): Minimum 1-1/8 inch.
 - b. Top Rail (Closer): Minimum 5-inch remaining after installation. Verify with closer manufacturer.
 - c. Bottom Rail: Minimum 1-1/8 inch after undercut.
 - d. Bottom Rail: 5-inch bottom-rail in doors indicated to have kick, mop, or armor plates.
 - e. Midrail: 5-inch midrail blocking, in doors indicated to have exit devices at location of exit device.

2.3 LOUVERS AND LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors:

1. Wood Species: Same species as door faces, painted to match door faces..
2. Profile: Flush rectangular beads.

3. At 20-minute, fire-rated, wood-core doors, provide wood beads and metal glazing clips approved for such use.
- B. Wood-Veneered Beads for Light Openings in Fire Doors: At fire-rated door locations except, 20-minute rated doors, provide manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire rating indicated. Include concealed metal glazing clips where required for opening size and fire rating indicated.
- C. Refer to Section 08 80 00 for glazing.

2.4 FABRICATION - GENERAL

- A. Fabricate wood doors to produce doors complying with following requirements:
 1. Fabricate fire rated doors in accordance with [AWI](#) Quality Standards and to [UL](#) or [Warnock Hersey](#), [ETL SEMKO division of Intertek \(WHI\)](#) requirements. Attach fire rating label to door and frame.
 2. Stiles, rails and core shall be fully bonded together with adhesive and sanded smooth prior to laminating of face veneer.
 3. Cross bands and faces for PC and FD type doors shall be laminated to core by the hot or cold plate process.
 4. Factory-prefit and pre-machine doors to fit frame opening sizes indicated with the following uniform clearances and bevels:
 - a. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory pre-machining.
 - b. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in [NFPA](#) 80 for fire-rated doors.
 - c. Locate hardware to comply with [DHI](#)-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, [DHI](#) A115-W series standards, and hardware templates.
 - d. Factory drill pilot holes for hinge and lock face plate screws.
 - e. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory pre-machining.
- B. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of doors required.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Louvers: Factory install louvers in prepared openings.
- C. Pre-Assembled Doors and Frames:
 1. Coordinate with Section 08 71 00 for all hardware requirements, including installation.

2.5 SHOP PRIMING

- A. Doors for Opaque (Painted) Finish:
 1. Shop prime faces and edges of doors, including cutouts, with two coat of wood primer specified in Section 09 90 00 "Painting".
 - a. Match primer-sealer color to color of finish coats; refer to Finish Schedule for color.

B. PLASTIC-LAMINATE-FACED DOORS

A. Interior Solid-Core Doors <Insert drawing designation>:

1. Grade: **[Premium]**.
2. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS.
3. Colors, Patterns, and Finishes: **[As selected by Architect from laminate manufacturer's full range of products]**.
4. Exposed Vertical Edges: **[Plastic laminate that matches faces]**.
5. Core: **[Either glued wood stave or structural composite lumber]**.
6. Construction: Three plies. Stiles and rails are bonded to core, then entire unit abrasive planed before faces are applied.
7. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before faces and crossbands are applied.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine installed door frames prior to hanging door.
 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
 2. Reject doors with defects.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation see Section 08 71 00, "Door Hardware".
- B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions and of referenced [AWI](#) standard and as indicated.
 1. Install fire-rated doors in corresponding fire-rated frames in accordance with requirements of [NFPA](#) No. 80.
- C. Job-Fit Doors:
 1. Field-verify dimensions of each new installed door frame; trim each door as required to properly fit each frame within specified dimensional tolerances; unequal trimming may be required.
 2. Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and matching.
 - a. Trim non-rated doors equally from both sides when fitting for width and from top and bottom when fitting for height. Do not trim more than 3/4" from each edge.
 3. Fitting Clearances for Non-Rated Doors: Provide 1/8" at jambs and heads; 1/16" per leaf at meeting stiles for pairs of doors; and 1/8" from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4" clearance from bottom of door to top of threshold.
 4. Fitting Clearances for Fire-Rated Doors: Complying with [NFPA](#) 80.

5. Bevel non-rated doors 1/8" in 2" at lock and hinge edges.
 6. Bevel fire-rated doors 1/8" in 2" at lock edge, trim stiles and rails only to extent permitted by labeling agency.
- D. Hang doors and adjust for proper clearances and smooth operation without binding.
1. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
 2. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- E. Field-Finished Doors: Refer to the following for finishing requirements:
1. Section 09 90 00 "Painting"
 2. Seal field cuts in top and bottom rails and for hardware with 2 coats of a VOC compliant paint or varnish.
- 3.3 ADJUSTING, CLEANING, AND PROTECTION
- A. Operation: Rehang or replace doors which do not swing or operate freely.
- B. Finished Doors: Refinish or replace doors damaged during installation.
- C. Clean door and dry wipe with a soft cloth.
- D. After installation, protect doors from damage as recommended by manufacturer during subsequent construction activities. Damaged doors will be rejected and shall be replaced at no additional cost to Owner.
- E. Protect doors from damage. Replace damaged units at no cost to the Owner.

END OF SECTION 08 14 00 (08200)

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access Doors and Frames of the Following Types:
 - a. Wall Access Doors
 - b. Ceiling Access Doors
 - c. Moisture Resistant Access Doors

1.2 REFERENCES

A. [ASTM International \(ASTM\)](#) Publications:

1. E119 "Standard Test Methods for Fire Tests of Building Construction and Materials"

B. [National Association of Architectural Metal Manufacturers \(NAAMM\)](#) Publications:

1. "Metal Finishes Manual"

C. [National Fire Protection Association \(NFPA\)](#) Publications:

1. NFPA 80 "Standard for Fire Doors, Fire Windows"
2. NFPA 252 "Standard Methods of Fire Tests of Door Assemblies"

D. [Underwriter's Laboratories, Inc. \(UL\)](#) Standards

1. UL 10B "Standard for Fire Tests of Door Assemblies"
2. UL 263 "Standard for Fire Tests of Building Construction and Materials"

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:

1. Shop Drawings and Samples:
 - a. Submit copies of Shop Drawings of all items specified herein to [\[Architect\]](#) for approval. Obtain approval of Drawings prior to proceeding with manufacturing. Shop Drawings shall indicate: Elevations of each door type; Details of each frame type; Location in the building for each item; Conditions at openings with various wall thicknesses and material; Typical and special details of construction; Methods of assembling sections; Locations and installation requirements for hardware; Size, shape, and thickness of materials; Joints and connections.

1.4 QUALITY ASSURANCE

- A. Access doors shall be fabricated in accordance with standards and specifications established by Steel Door Institute.
- B. Fire Rated Access Doors and Frames: Comply with [NFPA 80](#). Provide products listed by [UL](#) or another testing agency acceptable to local jurisdictions on each fire rated access door. Where required by local codes comply with the following:

1. [ASTM E119](#)

2. NFPA 252

3. UL 10B

4. UL 263

- C. Access panels shall be flush with finished wall or ceilings, except where panels are located in acoustic tile or paneling, the door shall be recessed to receive adjacent finish material.
- D. Access panel finishes shall be coordinated with the finish treatment of the area.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver access doors cartoned or crated to provide protection during transit and job storage.

PART 2 PRODUCTS

2.1 ACCESS UNITS

A. Wall Access Doors - Gypsum Board (Non-rated):

- 1. Door Size: Select from manufacturer's standard sizes to suit required opening as shown on Drawings.
- 2. Mounting: Flush installation in gypsum board wall construction with integral drywall bead.
- 3. Materials: Minimum 16 gauge steel door and frame.
- 4. Hardware:
 - a. Recessed screwdriver latch.
 - b. Concealed continuous hinge
- 5. Finish: Factory Primed for field finish.

B. Wall Access Doors- Gypsum Board (Fire-Rated):

- 1. Door Size: Select from manufacturer's standard sizes to suit required opening as shown on Drawings.
- 2. Fire Rating: [1] hour labeled.
- 3. Materials: Minimum 20 gauge steel door and 16 gauge steel frame.
- 4. Hardware:
 - a. Recessed screwdriver latch mechanism.
 - b. Concealed continuous hinge
 - c. Self-closing mechanism.
- 5. Finish: Factory Primed for field finish.

C. Ceiling Access Doors- Gypsum Board (Non-rated):

- 1. Door Size: Select from manufacturer's standard sizes to suit required opening as shown on Drawings.
- 2. Mounting: Flush installation in gypsum board ceiling construction with integral drywall bead.
- 3. Materials: Minimum 16 gauge steel door and frame.

4. Hardware:
 - a. Recessed screwdriver latch.
 - b. Concealed continuous hinge
5. Finish: Factory Primed for field finish.
- D. Ceiling Access Doors - Gypsum Board (Fire-Rated):
 1. Door Size: Select from manufacturer's standard sizes to suit required opening as shown on Drawings.
 2. Fire Rating: [\[1\]](#) hour labeled.
 3. Mounting: Flush installation in gypsum board ceiling construction with integral drywall bead.
 4. Materials: Minimum 20 gauge steel door and 16 gauge steel frame.
 5. Hardware:
 - a. Recessed screwdriver latch mechanism.
 - b. Concealed continuous hinge
 - c. Self-closing mechanism.
 6. Finish: Factory Primed for field finish.
- E. Moisture Resistant Access Doors (Non-rated):
 1. Door Size: Select from manufacturer's standard sizes to suit required opening as shown on Drawings.
 2. Mounting: Exposed Flange.
 3. Materials: Construct of #304 stainless steel.
 4. Hardware:
 - a. Recessed screwdriver latch.
 - b. Concealed continuous hinge
 5. Finish: Stainless Steel #4 Satin Finish.

2.2 FABRICATION

- A. Grind exposed welds smooth and fl
- B. Provide all required attachment devices and fasteners to secure units to substrates.

2.3 FINISHES

- A. Apply a primed finish to all ferrous metal surfaces furnished under this Section. Clean and chemically treat metal surfaces to assure maximum paint adherence. Follow with a dip or spray coat of rust-inhibitive metallic oxide, zinc chromate, or synthetic resin primer on all exposed surfaces. Finished surfaces shall be smooth and free from irregularities and rough spots. Each coat of paint shall be separately baked or oven dried.
 1. For steel finishes comply with [NAAMM](#)'s "Metal Finishes Manual for Architectural and Metal Products".

- B. For fire-rated access doors, furnish units with ceramic fiberboard panel insert, attach to outside face of door, ready for field painting.

PART 3 EXECUTION

3.1 GENERAL

- A. Verify rough openings for door and frame are correctly sized and located.
- B. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

- A. Install units and their accessories in accordance with final Shop Drawings, manufacturer's data, and as herein specified.
- B. Install frame plumb and level in wall and ceiling openings, flush with adjacent surfaces.. Position to provide convenient access to concealed work requiring access. Secure rigidly in place.

3.3 ADJUSTMENT

- A. Check and readjust operating finish hardware items in work just prior to final inspection.
- B. Remove and replace defective work including doors or frames which are warped, bowed, or otherwise damaged.

3.4 TOUCH-UP

- A. Immediately after erection of work, sand smooth any rusted or damaged areas of prime coat and touch-up of compatible air drying primer.

3.5 PROTECTION:

- A. Protect doors and frames from damage during transportation and at the job site; store at the site under cover on wood blocking or on suitable floors. After installation, protect doors and frames from damage during subsequent construction activities. Damaged work will be rejected and shall be replaced with new work. Factory enameled finished work shall be shipped in cartons or other suitable containers.

3.6 CLEANING:

- A. Upon completion, metal surfaces of doors and frames that are completely factory finished shall be thoroughly cleaned and touched-up as recommended by the door manufacturer.

END OF SECTION 08 31 00 (08310)

SECTION 08 41 13- ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior and interior storefront framing.
2. Exterior and interior manual-swing entrance doors and door frame units.

1.2 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by wind and by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Failure of operating units.

B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind Loads: As indicated on Drawings.

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to **3/4 inch (19 mm)**, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to $L/360$ of clear span or **1/8 inch (3.2 mm)**, whichever is smaller

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 2. Test Durations: 10 seconds.
- F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of [0.06 cfm/sq. ft. (0.03 L/s per sq. m)] of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of [1.57 lbf/sq. ft. (75 Pa)] [6.24 lbf/sq. ft. (300 Pa)].
- G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than [6.24 lbf/sq. ft. (300 Pa)].

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
- C. Samples: For each type of exposed finish required.
- D. Other Action Submittals:
1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.
- E. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Product test reports.
- G. Field quality-control reports.
- H. Maintenance data.
- I. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- E. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- F. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Arcadia, Inc.
 - 2. Arch Aluminum & Glass Co., Inc.
 - 3. CMI Architectural.
 - 4. Commercial Architectural Products, Inc.
 - 5. EFCO Corporation.
 - 6. Kawneer North America; an Alcoa company.
 - 7. Leed Himmel Industries, Inc.
 - 8. Pittco Architectural Metals, Inc.
 - 9. TRACO.
 - 10. Tubelite.
 - 11. United States Aluminum.
 - 12. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
 - 13. YKK AP America Inc.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: **ASTM B 209** (**ASTM B 209M**).
 - 2. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221** (**ASTM B 221M**).
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Structural Profiles: ASTM B 308/B 308M.
 - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Construction: Thermally broken
 - 2. Glazing System: Retained mechanically with gaskets on four sides
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials
- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
1. Door Construction: ~~2- to 2-1/4-inch~~ overall thickness, with minimum ~~0.125-inch-~~ (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior
 2. Door Design: As indicated
 - a. Accessible Doors: Smooth surfaced for width of door in area within ~~10 inches~~ (255 mm) above floor or ground plane.
 3. Glazing Stops and Gaskets: Square snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
- B. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."

2.6 ENTRANCE DOOR HARDWARE

- A. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 3. Opening-Force Requirements:
 - a. Egress Doors: Not more than ~~15 lbf~~ (67 N) to release the latch and not more than ~~30 lbf~~ (133 N) to set the door in motion
 - b. Accessible Interior Doors: Not more than ~~5 lbf~~ (22.2 N) to fully open door.
- B. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
 2. Quantities:
 - a. For doors up to ~~87 inches~~ high, provide 3 hinges per leaf.
 - b. For doors more than ~~87 and up to 120 inches~~ high, provide 4 hinges per leaf.
- C. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- D. Manual Flush Bolts: BHMA A156.16, Grade 1.

- E. Cylinders: As specified in Division 08 Section "Door Hardware."
 - 1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE".
- F. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- G. Operating Trim: BHMA A156.6.
- H. Removable Mullions: BHMA A156.3, extruded aluminum.
 - 1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.
- I. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet field conditions and requirements for opening force.
- J. Concealed Overhead Holders: BHMA A156.8, Grade 1.
- K. Surface-Mounted Holders: BHMA A156.16, Grade 1.
- L. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- M. Weather Stripping: Manufacturer's standard replaceable components.
- N. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- O. Silencers: BHMA A156.16, Grade 1.
- P. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (13 mm).
- Q. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.7 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.

- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from interior
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm).
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range

PART 3 - EXECUTION

3.1 INSTALLATION

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

4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in Division 08 Section "Glazing."
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.2 FIELD QUALITY CONTROL

- A. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 08 46 00 - SLIDING AUTOMATIC ENTRANCE DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior biparting-sliding, automatic entrance door assemblies.
- B. Related Sections include the following:
 - 1. Division 8 Section "Door Hardware" for hardware to the extent not specified in this Section.
 - 2. Division 8 Section "Glazing" for materials and installation requirements of glazing for automatic entrance doors.
 - 3. Division 26 Sections for electrical connections including conduit and wiring for automatic entrance door operators.

1.3 DEFINITIONS

- A. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.
- B. Safety Device: Device that prevents a door from opening or closing.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide automatic entrance door assemblies capable of withstanding structural loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Seismic Loads: As indicated on Drawings.

- C. Thermal Movements: Provide automatic entrance doors that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Operating Range: Minus 20 deg F to 130 deg F.
- E. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. of fixed entrance system area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..
- F. Opening-Force Requirements:
 - 1. Egress Doors: Not more than 50 lbf required to manually set door in motion if power fails, and not more than 15 lbf required to open door to minimum required width.
 - 2. Accessible Interior Doors: Not more than 5 lbf.
- G. Closing-Force Requirements: Not more than 30 lbf required to prevent door from closing.

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrance doors.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware mounting heights, 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.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Product Certificates: For each type of emergency-exit automatic entrance door, signed by product manufacturer.
- E. Qualification Data: For Installer, manufacturer, certified inspector, testing agency.
- F. Inspection reports.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for automatic entrance door assemblies.
- H. Maintenance Data: For door operators and control systems to include in maintenance manuals.

- I. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project and who employs a certified inspector.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Manufacturer Qualifications: A qualified manufacturer with company certificate issued by AAADM.
- C. Certified Inspector: Certified by AAADM.
- D. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- E. Source Limitations: Obtain automatic entrance door assemblies through one source from a single manufacturer.
- F. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of automatic entrance door assemblies and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- G. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."
- H. Power-Operated Door Standard: BHMA A156.10.
- I. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- J. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrance doors serving as a required means of egress.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify openings to receive automatic entrance door assemblies by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating automatic entrance door assemblies without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate size and location of recesses in concrete floors for recessed sliding tracks. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Templates: Obtain and distribute, to the parties involved, templates for doors, frames, and other work specified to be factory prepared for installing automatic entrance doors. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic entrance doors to comply with indicated requirements.
- C. Electrical System Roughing-in: Coordinate layout and installation of automatic entrance door assemblies with connections to power supplies and security access control system.

1.9 WARRANTY

- A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic entrance door assemblies that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Faulty operation of operators, controls, and hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 2. Warranty Period: Three years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 1. Warranty Period: 20 years from date of Substantial Completion.

1.10 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of automatic entrance door assembly Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper automatic entrance door assembly operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1. Engage a certified inspector to perform safety inspection after each adjustment or repair, and at end of maintenance period. Submit completed inspection form to Owner.
2. Perform maintenance, including emergency callback service, during normal working hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: The design for sliding automatic entrance doors is based on Series 1100 Ultra-Glide™; KM Systems, Inc.. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 1. Biparting-Sliding Units:
 - a. Besam Automated Entrance Systems, Inc.
 - b. DORMA Automatics; Div. of DORMA Group North America.
 - c. Dor-O-Matic, Inc.; an Ingersoll-Rand Company.
 - d. NABCO.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 1. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 2. Sheet and Plate: ASTM B 209.
 3. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Sealants and Joint Fillers: Refer to Division 7 Section "Joint Sealants."
- C. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107; of consistency suitable for application.
- D. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos; formulated for 30-mil thickness per coat.

2.3 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

- A. General: Provide manufacturer's standard automatic entrance door assemblies including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, and accessories required for a complete installation.
- B. Sliding Automatic Entrance Door:
 1. Configuration: Biparting-sliding doors, with two sliding leaves and sidelite on each side.

- a. Traffic Pattern: Two way.
 - b. Emergency Breakaway Capability: Sliding leaves only.
 - c. Mounting: Between jambs.
2. Combination Activation and Safety Device: Combination motion/presence detector.
 3. Activation Device: Motion detector mounted on each side of door header to detect pedestrians in activating zone and to open door.
 4. Safety Devices: Presence detector mounted to underside of door header to detect pedestrians in presence zone and to prevent door from closing.
 5. Finish: Finish framing, door(s), sidelite(s), and header with Class I, color anodic finish matching curtain wall framing.

2.4 COMPONENTS

- A. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.
 1. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.
- B. Stile and Rail Doors: Manufacturer's standard 1-3/4-inch- thick glazed doors with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.
 1. Glazing Stops and Gaskets: Beveled , snap-on, extruded-aluminum stops and preformed gaskets.
 2. Stile Design: Medium stile; 3-1/2-inch nominal width.
 3. Rail Design: 5-inch nominal height.
- C. Sidelites: Manufacturer's standard 1-3/4-inch- deep sidelites with minimum 0.125-inch- thick, extruded-aluminum tubular stile and rail members matching door design.
 1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.
- D. Glazing: As specified in Division 8 Section "Glazing."
- E. Headers: Fabricated from minimum 0.125-inch-thick extruded aluminum and extending full width of automatic entrance door units to conceal door operators, carrier assemblies, and roller tracks. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
 1. Mounting: Concealed, with one side of header flush with framing.
 2. Capacity: Capable of supporting doors up to 175 lb per leaf over spans up to 14 feet without intermediate supports.
 - a. Provide sag rods for spans exceeding 14 feet.
- F. Carrier Assemblies and Overhead Roller Tracks: Manufacturer's standard carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered ball-bearing-center steel

wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.

1. Rollers: Minimum two ball-bearing roller wheels and two antirise rollers for each active leaf.
- G. Threshold: Manufacturer's standard threshold members and bottom-guide track system, with stainless-steel ball-bearing-center roller wheels.
1. Configuration: No threshold across door opening and recessed, pin-guide track system at sidelites.
- H. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- I. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
- J. Emergency Breakaway Sign: BHMA A156.10; red background with 1-inch- high contrasting letters with the words "IN EMERGENCY PUSH TO OPEN."

2.5 DOOR OPERATORS

- A. General: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
1. Door Operator Performance: Provide door operators that will open and close doors and maintain them in fully closed position when subjected to Project's design wind pressures.
- B. Electromechanical Operators: Self-contained overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; UL 325; and with manual operation including spring closing with power off.
1. Operation: Power opening and power closing.
 2. Features:
 - a. Adjustable opening and closing speeds.
 - b. Adjustable backcheck and latching.
 - c. Adjustable hold-open time between 0 and 30 seconds.
 - d. Obstruction recycle.
 - e. On-off/hold-open switch to control electric power to operator.
 3. Mounting: Concealed.

2.6 ACTIVATION AND SAFETY DEVICES

- A. Motion Detectors: Self-contained, K-band-frequency, microwave-scanner units with metal or plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10; with relay hold time of not less than 2 to 10 seconds.
- B. Presence Detectors: Self-contained, infrared-scanner units with metal or plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10; with relay hold time of 1.5 seconds fixed. Detectors shall remain active at all times.
- C. Key Switch: Recess-mounted, door control switch with key-controlled actuator; enclosed in 2-by-4-inch junction box. Provide face plate engraved with letters indicating switch functions.
 - 1. Face Plate Material: Stainless steel.
 - 2. Functions: On-off, momentary contact.
 - 3. Mounting: Recess mounted, semiflush in wall.
- D. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.
- E. Opening-Width Control Switch: Two-position switch that in the normal position allows sliding doors to travel to full opening width and in the alternate position reduces opening to a selected partial opening width.

2.7 HARDWARE

- A. General: Provide units in sizes and types recommended by automatic entrance door and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish, unless otherwise indicated.
- B. Emergency Breakaway Hardware: Provide release hardware that allows panel to swing out in direction of egress to full 90 degrees from any position in sliding mode. Maximum force to open panel shall be 50 lbf according to BHMA A156.10. Interrupt powered operation of panel operator while in breakaway mode.
- C. Deadlocks: Manufacturer's standard deadbolt operated by exterior cylinder and interior thumb turn; with minimum 1-inch- long throw bolt; BHMA A156.5, Grade 1.
 - 1. Cylinders: BHMA A156.5, Grade 1, six-pin mortise type.
 - a. Keying: Integrate into building master key system.
 - 2. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.
 - 3. Two-Point Locking: Mechanism in stile of active door leaf that automatically extends lockbolt into overhead carrier assembly.
- D. Dustproof Strikes for All-Glass Doors: Recessed floor type, BHMA A156.16, Grade 1, to receive deadbolt.

- E. Automatic Locking: Electrically controlled device mounted in header that automatically locks door against sliding when in closed position. Provide fail safe operation if power fails.
 - 1. Include concealed, vertical-rod exit devices, UL 305, with latching into threshold and overhead carrier assembly and released by full-width panic bar; and that prevent emergency breakout doors from swinging and permit emergency egress.
 - 2. Include locking devices for sidelites to prevent manual breakout.
- F. Sliding Weather Stripping: Manufacturer's standard replaceable components complying with AAMA 701; made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- G. Weather Sweeps: Manufacturer's standard nylon brush sweep mounted to underside of door bottom.

2.8 FABRICATION

- A. General: Factory fabricate automatic entrance door assembly components to designs, sizes, and thicknesses indicated and to comply with indicated standards.
 - 1. Form aluminum shapes before finishing.
 - 2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
 - 3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match framing.
 - a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - b. Reinforce members as required to receive fastener threads.
 - 4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- B. Framing: Provide automatic entrance doors as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
 - 1. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
 - 2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
 - 3. Form profiles that are sharp, straight, and free of defects or deformations.
 - 4. Prepare components to receive concealed fasteners and anchor and connection devices.
 - 5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
 - 6. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.

7. Provide anchorage and alignment brackets for concealed support of assembly from the building structure.
 8. Allow for thermal expansion of exterior units.
- C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
- D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.
- E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."
- F. Hardware: Factory install hardware to the greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.
1. Provide sliding weather stripping, mortised into door, at perimeter of sliding doors.
- G. Activation and Safety Devices: Factory install devices in doors and headers.

2.9 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Black Anodic Finish: AAMA 611, AA-M12C22A44, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrance doors.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- B. Entrances: Install automatic entrance doors plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
 3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 4. Level recesses for recessed thresholds using nonshrink grout.
- C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 16 Sections.
- D. Activation and Safety Devices: Adjust devices to provide detection field and functions indicated.
- E. Glazing: Install glazing as specified in Division 8 Section "Glazing."
- F. Sealants: Comply with requirements specified in Division 7 Section "Joint Sealants" to provide weathertight installation.
1. Set framing members, thresholds, bottom-guide track system, and flashings in full sealant bed.
 2. Seal perimeter of framing members with sealant.
- G. Signage: Provide caution signs on each automatic entrance door, visible from both sides of door. Mount caution signs with centerline 58 inches above finished floor.
1. Emergency Breakaway Panels: Provide emergency breakaway sign visible to egress side of each automatic entrance door that has emergency breakaway capability. Mount signs adjacent to lock stile with centerline between 36 and 60 inches above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Inspector: Engage a certified inspector to test and inspect automatic entrance doors and prepare test and inspection reports.
- B. Testing Services: Certified inspector shall test and inspect each automatic entrance door to determine compliance of installed systems with applicable BHMA standards.
1. Inspection Report: Certified inspector shall submit report in writing to Architect and Contractor within 24 hours after inspection.

- C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 ADJUSTING

- A. Adjust door operators, controls, and hardware for smooth and safe operation, for weathertight closure, and complying with requirements in BHMA A156.10.
- B. Lubricate operating hardware and other moving parts.
- C. Readjust door operators and controls after repeated operation of completed installation equivalent to 3 days' use by normal traffic (100 to 300 cycles). Lubricate hardware, operating equipment, and other moving parts.
- D. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

3.5 CLEANING AND PROTECTION

- A. Clean glass and aluminum surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
 - 1. Comply with requirements in Division 8 Section "Glass and Glazing" for cleaning and maintaining glass.

3.6 DEMONSTRATION

- A. Engage a certified inspector to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrance doors and door operators.

END OF SECTION 084600

SECTION 08 51 13 ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes fixed aluminum-framed windows Type A, B, and C.

1.2 PERFORMANCE REQUIREMENTS

- A. Air, Water and Structural Performance Requirements:

When tested in accordance with cited test procedures, windows shall meet or exceed the following performance criteria, as well as those indicated in AAMA 101 and 101/I.S.2/A440-08 for performance grade of unit specified unless otherwise noted herein.

1. Air Test Performance Requirements:
 - a. Performance: Air infiltration maximum 0.30 cfm per square foot at 1.6 psf pressure differential when tested in accordance with ASTM E283 for sliding sealed products.
2. Water Test Performance Requirements:
 - a. No uncontrolled water leakage at 9 psf static pressure differential when tested in accordance with ASTM E331 and ASTM E547.
3. Structural Test Performance Requirements:
 - a. Uniform Load Deflection Test
 - 1) No deflection of any unsupported span L of test unit (framing rails, muntins, mullions, etc.) in excess of L/175 at both a positive and negative load of design test pressure when tested in accordance with ASTM E330.
 - 2) Structural reinforcing that is not standard on units being furnished is not allowed.
 - b. Uniform Load Structural Test:
 - 1) Unit to be tested at 1.5 x design test pressure, both positive and negative, acting normal to plane of wall in accordance with ASTM E330.
 - 2) No glass breakage; permanent damage to fasteners, hardware parts, or anchors; damage to make windows inoperable; or permanent deformation of any main frame or ventilator member in excess of 0.2% of its clear span.

- B. Forced Entry Resistance Test: ASTM F 588, Type and Grade as indicated for each Product.

- C. Thermal Performance Requirements

1. Perform thermal computer simulation in accordance with the configuration specified in NFRC 100.
2. Computed Thermal Transmittance (U-Value) shall not exceed 0.37 BTU/hr/sq.ft./°F for the whole window assembly.
3. Computed Solar Heat Gain Coefficient (SHGC) shall not exceed 0.42 for the whole window assembly.

1.3 SUBMITTALS

- A. Submit administrative requirements under provisions of Section 01 30 00.

- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings:
 - 1. Elevation for each style window specified indicating its size, glazing type, muntin type and design.
 - 2. Manufacturer's head, jamb and sill details and section views for each window type specified.
- D. Schedules:
 - 1. Provide a window schedule indicating the type, size, color, , and operation of each unit specified. Coordinate with window mark types found in the Contract Drawings.
- E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- F. Verification Samples: For each finish product specified, two samples representing actual product, color, and patterns. Samples may be subsequently installed on the project.
- G. Test Reports: Submit certified independent testing agency reports indicating window units meet or exceed specified performance requirements.

1.4 SYSTEM DESCRIPTION

- A. Operation: FIXED
- B. AAMA Rating: CW-PG60-FW when tested according to AAMA/WDMA/CSA 101/I.S.2/A440-08 at the gateway size of 60" x 60"
- C. Construction: 3 1/4 inch frame depth. Wall thickness: 0.062"/0.062" frame/sill. Factory finished extruded aluminum frame and sash members with integral structural polyurethane thermal break.
- D. Glazing: 7/8 inch insulating glass; back bedded with dual-sided adhesive butyl tape on the frame glazing leg, and secured in the interior with snap-in glazing beads and bulb gaskets.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All windows specified in this section shall be supplied by a manufacturer which has been fabricating/manufacturing commercial grade aluminum windows of similar quality and performance for a minimum of ten (10) years.
- B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing windows of the same type and scope as specified, preferably AAMA certified installers.
- C. Provide test reports from AAMA accredited laboratory certifying that window units are found to be in compliance with AAMA/WDMA/CSA 101/I.S.2/A440-08 and performance

standards listed above.

1. Test reports shall be accompanied by the window manufacturer's letter of certification stating that the tested window meets or exceeds criteria for the appropriate AAMA/WDMA/CSA 101/I.S.2/A440 test.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation in accordance with manufacturer's recommendations.
- B. Protect units against damage from the elements, construction activities and other hazards before, during, and after installation.

1.7 WARRANTY

- A. Window: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Crystal Window & Door Systems, Ltd., which is located at: 31-10 Whitestone Expressway, Flushing, NY 11354; Tel: 718. 961.7300; Tel: 800. 472.9988; Fax: 718.460.4594; Web: www.crystalwindows.com
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 Aluminum:

- A. Extruded aluminum prime billet 6063-T5 or 6063-T6 alloy for primary components; 6063-T5, 6063-T6, or 6061-T6 for structural components; all meeting the requirements of ASTM B221.
- B. Aluminum sheet alloy 5005 H 32 (for anodic finish), meeting the requirements of ASTM B209 or alloy 3003 H 14 (for painted or unfinished sheet).

2.3 Thermal Barrier:

- A. Structural Thermal Barrier:
 1. Structural thermal barrier shall consist of poured-in-place polyurethane polymer that shall transfer shear during bending and provide composite action between frame components.
- B. Non Structural Thermal Barriers:
 1. Non structural thermal barriers are used only in conjunction with structural thermal barriers. The purpose of non structural thermal barriers is to enhance thermal performance of the primary structural thermal barriers (polyamide struts) by inhibiting heat transfer through thermal radiation and convection. Non structural thermal barriers shall not be used as primary load carrying members.
 2. Rigid non structural thermal barriers shall be constructed of extruded polyvinylchloride (PVC).

2.4 GLASS

A. Glazing Materials:

1. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical. Design glass to resist design wind pressure based on glass type factors for short-duration load.
2. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
3. Strength: Where float glass is indicated, provide annealed float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
4. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated.
 - a. U-Factors: Total-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as BTU/sq.ft x h x deg F (W/sq. m x K).
 - b. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 - c. Visible Reflectance: Center-of-glazing values, according to NFRC 300.
5. Float Glass: ASTM C 1036, Type 1, Quality-Q3, Class 1 (clear) unless otherwise indicated.
6. Coated Glass: ASTM C 1376, Type 1, Quality-Q3, Class 1 (clear) unless otherwise indicated, of kind and condition indicated.
7. Laminated Glass: ASTM C 1172, Type 1, Quality-Q3, Class 1 (clear) unless otherwise indicated, of kind and condition indicated.

B. Insulating Glass Units:

1. Factory-assemble units consisting of sealed lites of glass separated by a PPG Intercept Spacer system consisting of a one-piece, metallic, U-channel design that creates an effective thermal barrier to help reduce conducted heat loss through the window.
2. Insulating glass units shall be sealed with an integral dessicant matrix and a butyl sealant extruded around the entire perimeter of the spacer to achieve a seal. The sealant applied is to be Dual Seal Equivalent (DSE). Interspace to be filled with air or argon gas as required by thermal computer simulation.
3. Insulating Glass Types: Low-E coated, insulating glass units.
 - a. Overall Unit Thickness: 7/8" (22mm)
 - b. Thickness of Each Glass Lite: 3/32", 1/8" or 1/4 inch
 - c. Outdoor Lite: Class 1 (Clear) float glass, or fully tempered float glass.
 - d. Interspace Content: Air or Argon Gas.
 - e. Indoor Lite: Class 1 (Clear) float glass, or fully tempered float glass.
 - f. Low-E Coating: Sputtered on second or third surface.
 - g. Glass Winter Night time U-Value: 0.26 maximum.
 - h. Solar Heat Gain Coefficient: 0.46 maximum.
 - i. Provide safety glazing labeling, if necessary.

2.5 WINDOW ACCESSORIES

Provide the following accessories as specified in the contract drawings. Finish to match window frames or as selected by the Architect:

A. Wrap Around Panning

- B. Preset Panning
- C. Snap Trim/Clips
- D. Expanders
- E. Receptors
- F. Subsills and Subsill Anchors
- G. Mullions and Mullion Covers
- H. Exterior Sills
- I. Interior Stools
- J. Muntins

2.6 FINISHES

- A. Conforming to AAMA 2604-05 specification, finish on all extruded aluminum shall consist of zero or near-zero VOC, organic POWDER COAT with a baked on super-durable thermosetting polyester resin, electro-statically applied on five-stage pre-treated aluminum surface. Equivalent to 50% Kynar polyvinylidene fluoride liquid paint finishes. Powder coat material to be as manufactured by Sherwin Williams or PPG Powder Coatings.
- B. Color to be selected from Manufacturer's Standard Color Chart (or custom-matched as required by project Architect/Owner).

2.7 Steel components including attachment fasteners shall be 300 series stainless steel except as noted.

2.8 Thermoplastic or thermo-set plastic caps, housings and other components shall be injection-molded nylon, extruded PVC, or other suitable compound.

2.9 Sealants:

- 1. Sealants shall comply with applicable provisions of AAMA 800 and/or Federal Specifications FS-TT-001 and 002 Series.
- 2. Frame joinery sealants shall be suitable for application specified and as tested and approved by window manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.4 ANCHORAGE

- A. Anchor window units and/or assemblies sufficiently to maintain permanent positions when subjected to normal thermal movement, specified building movement and specified wind loads.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Final operating adjustment shall be made after glazing work is complete. Operating sash and ventilator shall operate smoothly and shall be weathertight when in locked position
- C. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 DISPOSAL OF DEBRIS

- A. Remove all garbage off site and legally dispose of existing windows and debris generated from the installation of the new windows.

3.7 OPTIONAL FIELD TESTING

- A. At the discretion and expense of Owner or Owner's representative, perform on-site testing of installed units in conformance with AAMA 502 - Voluntary Specification for Field Testing of Windows and Sliding Glass Doors. Conduct air and water infiltration testing with the window manufacturer, contractor, and owner present.
- B. An AAMA accredited lab will be hired by the owner to perform the required testing.

3.8 ADJUSTMENT AND CLEAN UP

- A. Adjust all products, sash, vents, and hardware after installation, as necessary to provide proper operation and a weather tight installation
- B. Remove any labels and dirt from the window.

END OF SECTION 085113

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Work under this section comprises of furnishing and installing hardware specified and noted on drawings for a complete and operational system, including any electrified hardware components, systems, controls and hardware for aluminum entrance doors. Value engineering will not be permitted. **See Hardware Sets at end of section.**
Comply with Hampton Inn & Suites Brand Standards for all Hardware.

- B. Items include but are not limited to the following:

1. Hinges - Pivots
2. Flush Bolts – Automatic and Lever Extension
3. Exit Devices
4. Locksets and Cylinders
5. Push Plates - Pulls
6. Coordinators
7. Closers
8. Kick, Mop and Protection Plates
9. Wall & Floor Stops, Wall Bumpers, O.H. Controls, Door Flip Guards and protection plates.
10. Electrified Hold Open Devices, Magnetic Catches
11. Thresholds, Sound Gasketing and Door Bottoms, Sweeps,
12. Silencers, Door Viewers,
13. Miscellaneous Trim and Accessories
14. Electrified Hardware Items, Controls and Power Supplies

- 1.2 RELATED DOCUMENTS, drawings and general provisions of contract, including General and Supplementary Conditions, and Division 1 Specification sections, apply to this section.

- 1.3 RELATED WORK specified elsewhere that should be examined for its effect upon this section:

- A. Section 06 20 00 - Finish Carpentry
- B. Section 08 81 13 - Hollow Metal Doors and Frames
- C. Section 08 14 16 – Flush Wood Doors
- D. Section within 08 41 13 – Aluminum-Framed Entrances and Storefronts
- E. Division 16 - Electrical

- 1.4 REFERENCES SPECIFIED in this section subject to compliance as directed:

- A. NFPA-80- Standard for Fire Doors and Windows
- B. IBC – International Building Code
- C. ADA - The Americans with Disabilities Act - Title III - Public Accommodations
- D. ANSI-A 117.1-American National Standards Institute - Accessible and Usable Buildings and Facilities
- E. ANSI-A156.5-American National Standards Institute - Auxiliary Locks and Associated Products
- F. UFAS - Uniform Federal Accessibility Standards
- G. UL - Underwriter's Laboratories UL10C & NFPA 252
- H. WHI - Warnock Hersey International, Division of Inchcape Testing Services
- I. 2010 Building Code of New York State and Local Codes including Authority Having Jurisdiction.

1.5 SUBMITTALS

- A. **HARDWARE SCHEDULES:** Submit copies of schedule in accordance with Division 1, General Requirements. Prepare and submit for the Architects approval a complete schedule listing all items of finish hardware to be furnished and installed on the project. A vertical type schedule will be used as illustrated by the Sequence and Format for the Hardware Schedule as published by the Door and Hardware Institute. The schedule shall be reviewed prior to submittal by an Architectural Hardware Consultant who shall affix his or her SEAL attesting to the completeness and correctness of the schedule. Supply the schedules within two (2) weeks from date purchase order is received by the hardware supplier. Supplier must have facilities within 100 miles of the project. **HAND WRITTEN SCHEDULES WILL NOT BE PERMITTED.**
- B. Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.
- C. Certification of Compliance:
 - 1. Submit any information necessary to indicate compliance to all specifications as required.
 - 2. Submit a statement from the manufacturer that electronic hardware and systems being supplied comply with the operational descriptions exactly as specified.
- D. Submit samples as requested by the Owner.
- E. Templates for finish hardware items to be sent to related door and frame suppliers within three (3) working days of receipt of approved hardware schedule.
- F. **Wiring Diagrams:** Provide complete wiring diagrams for each opening requiring electrified hardware, except openings where only magnetic hold-opens are specified. Provide a copy with each hardware schedule submitted after approval. Supply a copy with delivery of hardware to jobsite and another copy to owner at time of job completion.
- G. Electrical components to be listed by opening in the hardware submittals.
- H. **Operational Descriptions:** Provide complete operational descriptions of electronic components listed by opening in the hardware submittals. Operational descriptions to detail how each electrical component functions within the opening incorporating all conditions of ingress and egress. Provide a copy with each hardware schedule submitted for approval. Supply another copy with delivery of hardware to jobsite and another copy to owner at time of job completion.
- I. **Elevation Drawings:** Provide elevation drawings of electronic hardware and systems identifying locations of the system components with respect to their placement in the door opening. Provide a copy with each hardware schedule submitted for approval. Supply another copy with delivery of hardware to jobsite and another copy to owner at time of job completion.

1.6 QUALITY ASSURANCE

- A. Hardware supplier shall be a qualified, Factory Authorized, direct distributor of the products to be furnished. The supplier shall be, or employ, a certified ARCHITECTURAL HARDWARE CONSULTANT, who is registered in the continuing education program as administered by the Door and Hardware Institute and who will be made available at

reasonable times to consult with the Architect and/or Owner regarding any matters affecting the finish hardware on this project. Supplier shall be within 100 miles radius of the project.

- B. Hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating U.L. (Underwriter's Laboratories) approved for fire. Exit devices in non-labeled openings to be listed for panic.
- C. Pre-Installation Conference for Electronic Hardware: Prior to installation of electronic hardware, arrange conference between supplier, installers and related trades to review materials, procedures and coordinating related work.
- D. Coordinate with electrical contractor.

1.7 DELIVERY, HANDLING AND PACKAGING

- A. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each item of hardware.
- B. Pack each item complete with all necessary parts and fasteners.
- C. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.

1.8 SEQUENCING AND SCHEDULING

Any part of the finish hardware required by the frame or door manufacturers or other suppliers that is needed in order to produce doors or frames is to be sent to those suppliers in a timely manner, so as not to interrupt job progress.

1.9 WARRANTY

Finish hardware shall be supplied with a one (1) year warranty against defects in materials and workmanship, commencing with contract completion of the project and all door closers to have a ten (10) year warranty.

PART 2 - PRODUCTS

2.1 FASTENERS

- A. Furnish with finish hardware all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.
- B. Furnish fastenings necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. All closers and exit devices on labeled wood doors shall be thru-bolted if required by the door manufacturer. Thresholds shall be fastened with machine screws and anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.
- C. Design of fastenings shall harmonize with the hardware as to material and finish.

2.2 ENVIRONMENTAL CONCERN FOR PACKAGING

Hardware shipped to the jobsite shall be packaged in biodegradable packs such as paper or cardboard boxes and wrapping. If non-biodegradable packing such as plastic, plastic bags or large amounts of Styrofoam is utilized, the Contractor will be responsible for the disposal of the non-biodegradable packing to a licensed or authorized collector for recycling of the non-biodegradable packing.

2.3 HINGES

- A. Hinges and pivots, including single and double acting types, pocket hinges, electric hinges and continuous aluminum geared hinges shall be of one manufacturer as listed for continuity and consideration of warranty.
- B. Provide five-knuckle, heavy-duty, button tip, full mortise template type hinges with non-rising loose pins. Provide non-removable pins for all out swinging doors.
- C. Exterior Door Hinges Provide out-swinging door hinges of solid bronze or stainless steel with non-removable pins or security studs.
- D. Interior Door Hinges Wrought steel, polished and plated to match specified finish. Furnish three (3) hinges up to 90 inches (2,286) high and one (1) additional hinge for every 30 inches (762) or fraction thereof.
- E. Size 4 1/2 inch x 4 1/2 inch for all 1 3/4 inch thick. Doors up to and including 48 inches wide, use 5 inch x 5 inch hinges.
- F. Where required to clear trim or permit doors to swing 180 degrees, furnish hinges of sufficient width.
- G. Furnish heavy weight hinges 5" on doors over 36 inches (914.4) in width.
- H. At labeled doors, use steel or stainless steel, bearing-type hinges. Doors equipped with closers use bearing-type hinges.
- I. Finishes
 - 1. Wood door hinges shall be plated to match adjacent hardware or as listed in the Hardware Sets.
 - 2. Interior hollow metal doors, hinges shall be US26D, stainless steel at exterior out swinging doors, unless otherwise required in the Hardware Sets.
- J. Acceptable Products: Hager, McKinney, Stanley

2.4 LOCKS AND LOCK TRIM

- A. Locksets, latch sets, electrified locksets and trim of one manufacturer listed for continuity of design and consideration of warranty.
- B. Furnish metal wrought box strike boxes and curved lip strikes with proper lip length to protect trim of the frame, but not to project more than 1/8 inch (3.2) beyond frame trim or the inactive leaf of a pair of doors. See hardware sets for lock types and functions.
- C. Cylindrical locksets and latchsets shall meet ANSI Grade 2 Commercial duty requirements.
 - a. Acceptable Products: PDQ Manufacturing, Hager, Yale
- D. Acceptable Products: Guestroom Entry Card Locks including Front Desk check in station and encoders, 2000 cards, Training and Lock Installation.
 - a. Acceptable Products: Saflok, Onity Entry Systems, Ving Card
- E. Finish: US26D, USUS32D

2.5 CYLINDERS AND KEYING

- A. Provide locks and exit devices requiring cylinders with 6-pin cylinders which comply with performance requirements of ANSI A156.5. All keys to be of nickel silver only.

- B. Furnish all locks and cylinders keyed to a simple master key system. All keying to be accomplished at the factory of the lock manufacturer. Field keying will not be permitted.
- C. Each cylinder or lock to be supplied with three (3) change keys.
- D. Six (6) master keys to be supplied for each master key group.
- E. Cylinders and keys shall be properly tagged to indicate their intended location and to enable the Owner, with a minimum of effort, to establish his key control system.
- F. Stamp all change keys with keyset symbol (VKC), but do not stamp with key section or biting number.
- G. Acceptable products: See Section 2.04C.

2.6 EXIT DEVICES

- A. Exit devices and trim, including electrified items, to be of one manufacturer as hereafter listed and in the hardware sets for continuity of design and consideration of warranty; electrified devices and trim to be the same series and design as mechanical devices and trim.
- B. Exit Devices to be "UL" listed for life safety. All exit devices for labeled doors shall have "UL" label for "Fire Exit Hardware". All devices mounted on labeled wood doors are to be thru-bolted or per the manufacturer's listing requirements. Devices to conform to NFPA 80 and OBC requirements.
- C. Exit devices of a heavy duty, chassis mounted design, with one piece removable covers, eliminating necessity of removing the device from the door for standard maintenance and keying requirements.
- D. Trim to be thru-bolted to the lock stile case. Lever design same as locksets.
- E. Exit device lever operating trim to be rated for a minimum of 1,000 inch pounds of pressure without allowing access.
- F. Rail assemblies of all exit devices shall be solid stainless steel, brass or bronze base material, plated to standard architectural finishes as required in the hardware sets. Painted or anodized aluminum finishes will not be considered acceptable for the heavy duty usage required on this project.
- G. Metal end caps to be standard with all exit devices.
- H. Chassis to be mounted and operable without rail and be operable for use during construction without subjecting the finished device to damage.
- I. Exit devices are to be by the same manufacturer. Deviations will NOT be permitted.
- J. Finish: USUS32D – Painted finish not allowed
- K. Acceptable Products: Hager 4500 Series, Dorma 9000 series or equal as approved by Architect and Owner

2.7 SURFACE MOUNTED DOOR CLOSERS

- A. Closers to be the product of a single manufacturer for continuity of design and consideration of warranty.
- B. Closers to be heavy duty, surface mounted, hydraulic type, with a one piece high strength cast iron case. Full rack and pinion constructed of heavy steel.
- C. Size closers in accordance with the manufacturer's recommendations at the factory.
- D. Closers to have adjustable spring power and separate tamper resistant, brass, non-critical regulating screw valves for closing speed, latching speed and back check control as a standard feature.
- E. Closer covers to be rectangular, full cover type of non-ferrous, non-corrosive material painted to match closer. GUESTROOM ENTRY DOOR MUST HAVE COVERS.
- F. Furnish heavy duty cold forged parallel arms.
- G. Supply appropriate arm assembly for each closer so that closer body and arm are mounted on non-public side of door opening and on the interior side of exterior openings, except where required otherwise in the hardware sets.
 - 1. Parallel arm mounted closers to be factory indexed to insure proper installation.
- H. Provide closers with special application and heavy-duty arms as specified in the hardware sets or as otherwise called for to insure a proper-operating, long-lasting opening.
- I. Finish: Sprayed enamel finish to match other hardware
- J. Acceptable Products:
 - a. Approved Manufacturers: Dorma, Hager Companies

2.8 ELECTRO MAGNETS

- A. Provide locking magnets as shown in the hardware sets and drawings.
 - a. Approved Manufacturers: Autocall or Dorma, Rixson-Firemark.

2.9 DOOR STOPS, HOLDERS, DOOR GASKETING, AND MISCELLANEOUS ITEMS

- A. Door stops are to be furnished for every door leaf. Each door to have either a floor, wall, or an overhead stop. Guest Room doors and Guest Bathroom doors to have special door stops and bumpers to prevent incidental damage; latches, and latch protection plates on doors and walls to prevent damage.
- B. Place door stops in such a position that they permit maximum door swing, but do not present a hazard or obstruction.
- C. Where overhead stops and holders are specified, or otherwise required for proper door operation, they are to be heavy duty and of extruded brass or bronze with no plastic parts.
- D. Finish: Same as other hardware, except use US32D (stainless steel).
- E. Acceptable Products: Hager Companies, Dorma , Don-Jo Manufacturing, Pemko, Alarm

Lock Code Lock , and Aiphone.

- F. Vinyl sound striping is required on all guestroom entry doors and must be DHSI "Cush-n-Seal" or Pemko.
- G. Tamper-proof, 180 degree one-way viewer with cover on guestroom side.
- H. Safety latch at entry door. Pemko PDL Ensure the door guard does not interfere with light switch.
- I. Provide door sweep equal to DHSI Cap Sweep #CS36 or Pemko's 2343 or 2173.
- J. Provide special thresholds as per hardware sets.
- K. Connecting doors to receive latch set, thumb turn deadbolt with 1" throw and blank plate on each door, sound stripping on both doors, door sweeps / drops, threshold, and safety latch on each door.

2.10 PUSH PLATES, DOOR PULLS, AND KICKPLATES

- A. Push plates, door pulls, kick plates and other miscellaneous hardware as listed in hardware sets. Equivalent products as manufactured by Hager, Ives, Rockwood, Trimco are acceptable. All doors with doors closers will have kick plates.
- B. Kick plates to be 8 inches high and Mop plates to be 6 inches high, both by 2 inches or 1 inch less than door width as specified. They are to be of 16 gauge thick bronze, brass, or stainless steel. For doors with louvers or narrow bottom rails, kick plate height to be 1 inch less than the dimension shown from the bottom of the door to the bottom of the louver or glass.
- C. Armor plates, edge guards and other protective hardware are to be supplied in sizes as scheduled in the hardware sets.
- D. Finish: USUS32D.

2.11 FLUSH BOLTS AND COORDINATORS

- A. Provide Flush bolts with Dust Proof Strikes as indicated in the hardware sets. Finish to match adjacent hardware.

2.12 THRESHOLDS AND GASKETING

- A. Provide materials and finishes as listed in hardware sets. Equivalent product by Pemko, Zero or Reese are acceptable. All thresholds must be in accordance with the requirements of the ADA, ANSI A117.1 and UL10B.
- B. Provide threshold with machine screws and lead anchors. Supply necessary anchoring devices for weather-strip and sound seal.

2.13 FINISHES

- A. The finishes for hardware are listed in this specification and the hardware sets.
- B. Special care shall be taken to make uniform the finish of all various manufactured items.

- C. Extruded aluminum products, except for thresholds, continuous geared hinges and specified gasketing, are not acceptable.

2.14 DOOR SILENCERS

Furnish door silencers at all openings without gasketing. Provide two (2) at each pair of doors and three (3) for each single door.

2.15 PROPRIETARY PRODUCTS

- A. References to specific products are used to establish minimum standards of utility, function and quality. Unless otherwise approved provide only the specified product.
- B. All other materials, not specifically described, but required for a complete and proper finish hardware installation, are to be selected by the Contractor, subject to the approval of the Architect.
- G. The **OWNER** reserves the right to approve all the substitutions proposed for this specification. All requests for substitution to be made prior to bid in accordance with Division 1, General Requirements, and are to be in writing, hand delivered to the Architect. All requests to be accompanied by two (2) copies of the manufacturer's brochures and a physical sample of each item in the appropriate design and finish.

2.16 OWNER'S STOCK; at the completion of the project, supply to the Owner the following items:

- A. One (1) complete biting list of key cuts
- B. One (1) set of instruction sheets for each item furnished
- C. One (1) each of any non-standard tool for installation of each non-standard item furnished.
- D. Fifty (50) key blanks of each section used
- E. Furnish one (1) **key cabinet** with 50 percent capacity to be installed in location per Owner's direction. Wall mounted.

PART 3 - EXECUTION

3.1 INSTALLATION OF FINISH HARDWARE

- A. Hardware shall be installed by experienced finish hardware installers.
- B. Check hardware against the reviewed hardware schedule upon delivery. Store the hardware in a dry, secure location to protect against loss and damage.
- B. Install finish hardware in accordance with approved hardware schedule and manufacturers' printed instructions. Prefit hardware before finish is applied; remove and reinstall after finish is complete and dry. Install and adjust hardware so that parts operate smoothly, close tightly, and do not rattle.
- D. Mortise and cutting to be done neatly, and evidence of cutting to be concealed in the finished work.
- E. Protect all finish hardware from scratching or other damage.

Hardware Set 1

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	HOTEL LCOK	QUANTUM ADB x RFID-BLE x CONTINENTAL - NO KEY	US26D	SZ
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
1	EA	WALL STOP	236W	US32D	HA
1	EA	THRESHOLD	EV2325BL-36"	BLACK	PE
1	EA	GASKET	S773D17	BRN	PE
1	EA	SWEEP	2173AV-36"	ALUM	PE
1	EA	PRIVACY LATCH	PDL	26D/15	PE
1	EA	VIEWER	1759 (C/L @ 60" AFF)	US26D	HA

Hardware Set 1A ADA UNIT ENTRY

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	HOTEL LCOK	QUANTUM ADB x RFID-BLE x CONTINENTAL - NO KEY	US26D	SZ
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
1	EA	WALL STOP	236W	US32D	HA
1	EA	THRESHOLD	EV2325BL-36"	BLACK	PE
1	EA	GASKET	S773D17	BRN	PE
1	EA	SWEEP	2173AV-36"	ALUM	PE
1	EA	PRIVACY LATCH	PDL	26D/15	PE
1	EA	VIEWER	1759 (C/L @ 60" AFF)	US26D	HA
1	EA	VIEWER	1759 (C/L @ 43" AFF)	US26D	HA

Hardware Set 2

Each to Receive:

1	EA	ADA PULLS	BF105 x BF105 x BTB	US32D	RO
1	EA	ADA PULLS	BF105	US32D	RO
1	EA	SLIDING DOOR HW	W60/6 (3'0" DOOR)	US32D	PE
1	EA	CHANNEL INSERT	EPD3BL-36	BLACK	PE

Hardware Set 3

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" 1279	US26D	HA
1	EA	PRIVACY	2540 x 2-3/4" WTH x ASA	US26D	HA
1	EA	WALL STOP	236W	US32D	HA
3	EA	SILENCERS	SR64	GRAY	IV

Hardware Set 4

Each to Receive:

2	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
4	EA	SPRING HINGE	4-1/2" x 4-1/2" 1250	US26D	HA
2	EA	DEADLOCK	3221-2-3/4" (THUMBTURN ON PULL SIDE) C/L 48" AFF	US26D	HA
2	EA	EXIT LATCH	2525 x 2-3/4" WTH x ASA	US26D	HA
2	EA	WALL STOP	236W	US32D	HA
1	EA	THRESHOLD	ADJ2325V14-36" BL	BLACK	PE
2	EA	GASKET	S88D17	BRN	PE
2	EA	DOOR BOTTOM	2170WV36UN	WHITE	PE

Hardware Set 5 NOT USED

Hardware Set 6

Each to Receive:

ALL HARDWARE PROVIDED BY ALUMINUM DOOR SUPPLIER.

Hardware Set 6A

Each to Receive:

ALL HARDWARE PROVIDED BY BYPASS DOOR SUPPLIER.

Hardware Set 7

Each to Receive:

1	EA	ACCESS CONTROL	SAFLOK REMOTE READER	BLK	SZ
1	EA	POWER SUPPLY	32280 RCU		SZ

BALANCE OF HARDWARE PROVIDED BY ALUMINUM DOOR SUPPLIER.

Hardware Set 7A

Each to Receive:

1	EA	EXIT DEVICE	4501 -RIM-F 36" x 1-3/4"	US32D	HA
1	EA	EXIT TRIM	MT RFID-BLE x CONTINENTAL	US32D	SZ
1	EA	GASKET	A2390	N/A	SZ

BALANCE OF HARDWARE PROVIDED BY ALUMINUM DOOR SUPPLIER.

Hardware Set 7B

Each to Receive:

ALL HARDWARE PROVIDED BY ALUMINUM DOOR SUPPLIER.

Hardware Set 8

Each to Receive:

1	EA	HOTEL LCOK	QUANTUM ADB x RFID-BLE x CONTINENTAL - NO KEY	US26D	SZ
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BALANCE OF HARDWARE PROVIDED BY ALUMINUM DOOR SUPPLIER.

Hardware Set 9

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	LOCKSET	3570 x 2-3/4" x WTH x H1 x CMK x 3 KEYS x VKC	US26D	HA
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PUSH SIDE MOUNT)	689	HA
1	EA	KICK PLATE	190S 8" x 2" LWOD	US32D	HA
1	EA	WALL STOP	236W	US32D	HA
3	EA	SILENCERS	SR64	GRAY	IV

Hardware Set 9A

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1191	US32D	HA
1	EA	LOCKSET	3570 x 2-3/4" x WTH x H1 x CMK x 3 KEYS x VKC	US26D	HA
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
1	EA	KICK PLATE	190S 8" x 2" LWOD	US32D	HA
1	EA	WALL STOP	236W	US32D	HA
1	EA	GASKET	S88D17	BRN	PE

Hardware Set 9B

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279-NRP	US26D	HA
1	EA	LOCKSET	3570 x 2-3/4" x WTH x H1 x CMK x 3 KEYS x VKC	US26D	HA
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PUSH SIDE MOUNT)	689	HA
1	EA	WALL STOP	236W	US32D	HA
3	EA	SILENCERS	SR64	GRAY	IV

Hardware Set 9C

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	LOCKSET	3570 x 2-3/4" x WTH x H1 x CMK x 3 KEYS x VKC	US26D	HA
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
1	EA	WALL STOP	236W	US32D	HA
3	EA	SILENCERS	SR64	GRAY	IV

Hardware Set 10

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279-NRP	US26D	HA
1	EA	LOCKSET	3580 x 2-3/4" x WTH x H1 x CMK x 3 KEYS x VKC	US26D	HA
1	EA	WALL STOP	236W	US32D	HA
3	EA	SILENCERS	SR64	GRAY	IV

Hardware Set 11

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	HOTEL LCOK	QUANTUM ADB x RFID-BLE x CONTINENTAL - NO KEY	US26D	SZ
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
1	EA	KICK PLATE	190S 8" x 2" LWOD	US32D	HA
1	EA	WALL STOP	236W	US32D	HA
1	EA	GASKET	S88D17	BRN	PE

Hardware Set 12

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	PRIVACY	2540 x 2-3/4" WTH x ASA	US26D	HA
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
1	EA	KICK PLATE	190S 8" x 2" LWOD	US32D	HA
1	EA	WALL STOP	236W	US32D	HA
3	EA	SILENCERS	SR64	GRAY	IV
1	EA	COAT HOOK	BL6610	US26D	HA

Hardware Set 12A

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1191	US32D	HA
1	EA	PRIVACY	2540 x 2-3/4" WTH x ASA	US26D	HA
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
1	EA	KICK PLATE	190S 8" x 2" LWOD	US32D	HA
1	EA	WALL STOP	236W	US32D	HA
3	EA	SILENCERS	SR64	GRAY	IV
1	EA	COAT HOOK	BL6610	US26D	HA

Hardware Set 13

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	LOCKSET	3550 x 2-3/4" x WTH x H1 x CMK x 3 KEYS x VKC	US26D	HA
1	EA	WALL STOP	236W	US32D	HA
3	EA	SILENCERS	SR64	GRAY	IV

Hardware Set 14

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	HOTEL LCOK	QUANTUM ADB x RFID-BLE x CONTINENTAL - NO KEY	US26D	SZ
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
1	EA	WALL STOP	236W	US32D	HA
3	EA	SILENCERS	SR64	GRAY	IV

Hardware Set 15

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1191-NRP	US26D	HA
1	EA	LOCKSET	3580 x 2-3/4" x WTH x H1 x CMK x 3 KEYS x VKC	US26D	HA
1	EA	DOOR CLOSER	5200 -MLT-ADJ -FC- 5957 (HD CUSH STOP)	689	HA
1	EA	KICK PLATE	190S 8" x 2" LWOD	US32D	HA
1	EA	THRESHOLD	271A-36" x WSL10	ALUM	PE
1	EA	GASKET	S88D17	BRN	PE
1	EA	SWEEP	315CN-36"	ALUM	PE
1	EA	RAIN DRIP CAP	346C-40"		PE

Hardware Set 16 NOT USED

Hardware Set 17

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1168	US26D	HA
1	EA	LATCHSET	3510 x 2-3/4" WTH x ASA	US26D	HA
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PUSH SIDE MOUNT)	689	HA
1	EA	KICK PLATE	190S 8" x 2" LWOD	US32D	HA
1	EA	WALL STOP	236W	US32D	HA
1	EA	GASKET	S88D17	BRN	PE

Hardware Set 18

Each to Receive:

ALL HARDWARE PROVIDED BY ALUMINUM DOOR SUPPLIER.

Hardware Set 19

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	HOTEL LCOK	QUANTUM ADB x RFID-BLE x CONTINENTAL - NO KEY	US26D	SZ
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
1	EA	WALL STOP	236W	US32D	HA
1	EA	GASKET	S88D17	BRN	PE

Hardware Set 20

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1191	US32D	HA
1	EA	LOCKSET	3580 x 2-3/4" x WTH x H1 x CMK x 3 KEYS x VKC	US26D	HA
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
2	EA	ARMOR PLATE	190S 34" x 38" x UL	US32D	HA
1	EA	WALL STOP	236W	US32D	HA
1	EA	GASKET	S88D17	BRN	PE

Hardware Set 20A

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1168	US26D	HA
1	EA	LOCKSET	3580 x 2-3/4" x WTH x H1 x CMK x 3 KEYS x VKC	US26D	HA
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
2	EA	ARMOR PLATE	190S 34" x 38" x UL	US32D	HA
1	EA	WALL STOP	236W	US32D	HA
1	EA	GASKET	S88D17	BRN	PE

Hardware Set 21

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	PRIVACY	2540 x 2-3/4" WTH x ASA	US26D	HA
1	EA	FLOOR STOP	243F	US26D	HA
3	EA	SILENCERS	SR64	GRAY	IV

Hardware Set 22

Each to Receive:

6	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
2	EA	EXIT TRIM	45BE-WTH	US32D	HA
2	EA	EXIT DEVICE	4501 -SVR-F x 1-3/4"	US32D	HA
2	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PUSH SIDE MOUNT)	689	HA
2	EA	KICK PLATE	190S 8" x 1" LWOD	US32D	HA
2	EA	MAG HOLDER	1504-AQN5 (EST)	ALUM	BY
1	EA	GASKET	S88D20	BRN	PE
2	EA	ASTRAGAL	18041CNB-80"	ALUM	PE

Hardware Set 23 NOT USED

Hardware Set 24

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1191-NRP	US26D	HA
1	EA	EXIT DEVICE	4501-RIM (EXIT ONLY)	US32D	HA
1	EA	DOOR CLOSER	5200 -MLT-ADJ -FC- 5957 (HD CUSH STOP)	689	HA
1	EA	KICK PLATE	190S 8" x 2" LWOD	US32D	HA
1	EA	THRESHOLD	271A-36" x WSL10	ALUM	PE
1	EA	GASKET	S88D17	BRN	PE
1	EA	SWEEP	315CN-36"	ALUM	PE
1	EA	RAIN DRIP CAP	346C-40"	ALUM	PE

Hardware Set 25

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	EXIT DEVICE	4501 -RIM-F 36" x 1-3/4"	US32D	HA
1	EA	EXIT TRIM	45BE-WTH	US32D	HA
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
1	EA	KICK PLATE	190S 8" x 2" LWOD	US32D	HA
1	EA	WALL STOP	236W	US32D	HA
1	EA	GASKET	S88D17	BRN	PE

Hardware Set 25A

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	EXIT DEVICE	4501 -RIM-F 36" x 1-3/4"	US32D	HA
1	EA	EXIT TRIM	MT RFID-BLE x CONTINENTAL	US32D	SZ
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PULL SIDE MOUNT)	689	HA
1	EA	KICK PLATE	190S 8" x 2" LWOD	US32D	HA
1	EA	WALL STOP	236W	US32D	HA
1	EA	GASKET	S88D17	BRN	PE

Hardware Set 26

Doors:

Each to Receive:

1	EA	HOTEL LCOK	QUANTUM ADB x RFID-BLE x CONTINENTAL - NO KEY	US26D	SZ
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BALANCE OF HARDWARE PROVIDED BY ALUMINUM DOOR SUPPLIER.

Hardware Set 27

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1168	US26D	HA
1	EA	LOCKSET	3570 x 2-3/4" x WTH x H1 x CMK x 3 KEYS x VKC	US26D	HA
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PUSH SIDE MOUNT)	689	HA
1	EA	KICK PLATE	190S 8" x 2" LWOD	US32D	HA
1	EA	FLOOR STOP	243F	US26D	HA
1	EA	GASKET	S88D17	BRN	PE

Hardware Set 28

Each to Receive:

3	EA	HINGE	4-1/2" x 4-1/2" BB1279	US26D	HA
1	EA	LOCKSET	3580 x 2-3/4" x WTH x H1 x CMK x 3 KEYS x VKC	US26D	HA
1	EA	KICK PLATE	190S 8" x 2" LWOD	US32D	HA
1	EA	FLOOR STOP	243F	US26D	HA
3	EA	SILENCERS	SR64	GRAY	IV

Hardware Set 29 NOT USED

Hardware Set 30

Each to Receive:

6	EA	HINGE	4-1/2" x 4-1/2" BB1279-NRP	US26D	HA
2	EA	FLUSH BOLT	282D-12"	US26D	HA
1	EA	D.P. STRIKE	280X	US26D	HA
1	EA	LOCKSET	3580 x 2-3/4" x WTH x TWx7/8"LTC x H1 X CMKx3 KEYS x VKC	US26D	HA
1	EA	DOOR CLOSER	5300-MLT-ADJ-FC (PUSH SIDE MOUNT) (ACTIVE LEAF)	689	HA
1	EA	OH STOP	10 SERIES (INACTIVE LEAF)	689	RF
2	EA	KICK PLATE	190S 8" x 1" LWOD	US32D	HA
1	EA	GASKET	S88D20	BRN	PE
1	EA	ASTRAGAL	357SP84	PC	PE

Hardware Set 31 Miscellaneous Items

Each to Receive:

1	EA	KEY CABINET	1201		LU
1	EA	RFID ENCODER	CERPF6000RFID		SZ
1	EA	INSTALL DISK	7081602-PMSPMS/POS		SZ
1	EA	TRAINING CD	DOC-CD-6000		SZ
1,000	EA	MIFARE MINI 320	10950RFID		SZ
1	EA	START UP KIT	QRfid-KIT		SZ
1	EA	HILTON SYS6000	BLE KEY EXTRACTION		SZ
1	EA	BLE ACTIVATION	BLE BROKER ASSIGNMENT/TRIP CHARGE		SZ

END OF SECTION 08 71 00 (087100)

SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Types of work in this Section include glass and glazing for:
 - a. Float Glass
 - b. Tempered Glass
 - c. Insulated Units
 - d. Polished Wire Glass
 - e. Fire Rated Safety Glass
 - f. Mirrors

1.2 REFERENCES

A. [American Architectural Manufacturers Association \(AAMA\)](#) Publications:

1. 800-08 "Voluntary Specifications and Test Methods for Sealants"

B. [American National Standards Institute \(ANSI\)](#) Publications:

1. Z97.1 "Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings"

C. [ASTM International \(ASTM\)](#) Publications:

1. C920 "Standard Specification for Elastomeric Joint Sealants"
2. C1036 "Standard Specification for Flat Glass"
3. C1048 "Standard Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass"
4. C1172 "Standard Specification for Laminated Architectural Flat Glass"
5. C1376 "Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Glass"
6. E774 "Standard Specification for Sealed Insulating Glass Units"
7. E1300 "Standard Practice for Determining Load Resistance of Glass in Buildings"

D. [Consumer Product Safety Commission \(CPSC\)](#) Publications:

1. 16 [CFR](#) 1201 - "Safety Standard for Architectural Glazing Materials"

E. [Glass Association of North America \(GANA\)](#)

1. "GANA Glazing Manual"
2. "FGMA Sealant Manual"

F. [Insulating Glass Manufacturers Alliance \(IGMA\)](#) Publications:

1. SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units"

G. [National Glass Association \(NGA\)](#)

1. Glazier Certification Program

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data: Submit manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions.
 - 2. Compatibility and Adhesion Test Report: Submit statement from sealant manufacturer indicating that glass and glazing materials have been tested for compatibility and adhesion with glazing sealants and interpreting test results relative to material performance, including recommendations for primers and substrate preparation needed to obtain adhesion.
- B. Samples: Submit, for verification purposes, 12" square samples of each type of glass indicated except for clear single pane units, and 12" long samples of each color required (except black) for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative of adjoining framing system in color. Sample requirement may be waived by Owner's Representative at their discretion.
- C. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1.4 QUALITY ASSURANCE

- A. Glazing Standards: Comply with recommendations of the [Glass Association of North America \(GANA\)](#) "Glazing Manual" and "Sealant Manual" except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or other referenced standards.
- B. Safety Glazing Products: Comply with testing requirements in 16 [CFR](#) 1201 and, for wired glass, [ANSI](#) Z97.1.
 - 1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the [Safety Glazing Certification Council \(SGCC\)](#) or another certification agency acceptable to authorities having jurisdiction.
- C. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. [IGMA](#) Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
- D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the [Insulating Glass Certification Council, Inc.](#).
- E. Single Source Responsibility for Glass: To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source for each type and class required.

- F. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation or other causes.

1.7 WARRANTY

- A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.
- B. All material shall be free from manufacturer defects and installation workmanship. Any material or workmanship judged to be defective shall be replaced at no cost to the Owner.
- C. Insulating glass units shall be jointly guaranteed for a period of ten (10) years by the manufacturer and installer against obstruction of vision between interior glass surfaces caused by failure of the hermetic seal. Units damaged during guarantee period shall be replaced at no cost to the Owner.

PART 2 PRODUCTS

2.1 ACCEPTABLE GLASS MANUFACTURERS

- A. All glass shall be new material, graded under [ASTM](#) 1036.
- B. All glass in related area shall be from one manufacturer.

2.2 GLASS MATERIALS

- A. Refer to Drawings for location of glass.
- B. Glass [I]: Clear Float Glass: [ASTM](#) C1036, Type 1 (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), as manufactured by one of the following:
- C. Glass [II]: Tempered Glass: 1/4", Condition A (uncoated surfaces), Type 1 (transparent glass, flat), Class 1 (clear), Quality q3, clear, fully tempered safety glass (meet requirements of [ANSI](#) Z97.1).
1. All tempered glass shall conform to [ANSI](#) Z97.1, [ASTM](#) C1048, and Federal Standard [CPSC](#) 16 [CFR](#) 1201. Tempered glass shall bear permanent monogram indicating tempered quality. Fabrication marks on tempered glass shall be located to be concealed in completed installation.
 2. Color: Clear to match aluminum window glazing, Section 08 51 13.

- D. Glass [\[III\]](#): Coated Low Emissivity Glass: 1/4", Condition C (other coated glass), Type I (transparent glass, flat), Class I (clear), Quality q3 (glazing select), with coating type and performance characteristics complying with requirements specified below:
 - 1. Low E Coating: Side [\[2\]](#) [\[3\]](#) on insulated units.
- E. Sealed Insulating Glass Units
 - 1. Provide preassembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E774 for performance classification indicated as well as with other requirements specified for glass characteristics, air, space, sealing system, sealant, space material, and desiccants.
 - a. Thickness of Each Pane: 1/4"
 - b. Air Space Thickness: 1/2"
 - c. Sealing System: Manufacturer's Standard Dual Seal
 - d. Desiccant: Manufacturer's Standard - Either Molecular Sieve or Silica Gel or Blend of Both
 - e. Spacer Material: Manufacturer's Standard Metal, with Bronze Anodized Finish
 - 2. Exterior Pane of Glass: Glass Type [\[II\]](#)
 - 3. Interior Pane of Glass: Glass [\[III\]](#)
- F. Glass [\[IV\]](#): Wire Glass: Type II, Class I (translucent), Quality q8 (glazing), complying with [ANSI](#) Z97.1, 1/4" thick; Form I (wired, polished both sides), mesh M2 (square).

2.3 FIRE-RESISTIVE GLAZING PRODUCTS

- A. Fire-Resistive, Ceramic Glazing Material: Proprietary product in the form of clear flat sheets psf, permanently labeled with appropriate marks of testing and inspecting agency, acceptable to authorities having jurisdiction, showing product complies with fire-resistive installation indicated, and as follows:
 - 1. Safety Glass: Shall conform to [ANSI](#) Z97.1, [ASTM](#) C1048, and Federal Standard [CPSC](#) 16 [CFR](#) 1201.
 - 2. Polished on both surfaces, transparent with minimum visible light transmission of 85 percent.

2.4 MIRRORS

- A. Mirror glazing "select" quality float glass complying with [ASTM](#) C1036 and [CPSC](#) 16 [CFR](#) 1201, 1/4" thick.
- B. Silvering: Provide electro-deposited silvering in two coats.
- C. Exposed edges ground smooth and polished.
- D. Mirror sizes indicated on the drawings. Extend mirror to within 1" of adjacent walls, on each end, in one piece.
- E. Mirror Adhesive System:
 - 1. Provide adhesive specifically formulated for setting mirrors that is compatible with glass coating and mounting substrate.
- F. Exposed Mirror Clips:

1. Top Clip: 9/16" wide x 1-1/4" long; Model No. 318; [Knape & Vogt](#). (800-253-1561)
2. Bottom Clip: Continuous low profile clip at base.

2.5 ELASTOMERIC GLAZING SEALANTS AND PREFORMED GLAZING TAPES

- A. General: Provide products of type indicated and complying with the following requirements:
1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
 2. Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.
 3. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with [ASTM](#) C920 requirements, including those for Type, Grade, Class and Uses.
 4. Colors: Provide color of exposed sealants indicated or, if not otherwise indicated, as selected by Owner's Representative from manufacturer's standard colors.
- B. Preformed Butyl-Polyisobutylene Glazing Tape: Provide manufacturer's standard solvent-free butyl-polyisobutylene formulation with a solids content of 100 percent; complying with [AAMA](#) 800-08; in extruded tape form; non-staining and non-migrating in contact with nonporous surfaces; packaged on rolls with a release paper on one side; with or without continuous spacer rod as recommended by manufacturers of tape and glass for application indicated.
- C. Sealants: Provide structural and weatherseal sealants recommended by the manufacturer of the glazing system.
1. Refer to Section 07920 (07 92 00) - for requirements.
- D. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Provide the curtain wall manufacturer's permanent nonmigrating types compatible with sealants and suitable for joint movement and sealing requirements.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. Compatibility: Provide materials with proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.
- D. Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application indicated.
- E. Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.
- F. Compressible Filler Rods: Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 5-10 psi compression strength for 25 percent deflection.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Require Glazier to inspect work of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. Obtain Glazier's written report listing conditions detrimental to performance of glazing work.
 - 1. Do not allow glazing work to proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

3.3 GLAZING, GENERAL

- A. Comply with combined printed recommendations of glass manufacturers, of manufacturers of sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.
- B. Protect glass from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance and appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- D. Anchor components securely in place in the manner indicated. Shim and allow for movement resulting from changes in thermal conditions. Provide separators and isolators to prevent corrosion, electrolytic deterioration, and "freeze-up" of moving joints.
- E. Glazing: Inspect glass and framing for compliance with manufacturing and installation tolerances, including size, squareness, and offsets at corners; for existence of minimum face or edge clearances; and for effective sealing of joinery.
 - 1. Avoid point loading of glass. Do not proceed with glazing work until unsatisfactory conditions have been corrected. Do not field-cut glass.
 - 2. Field-Glazed Structural Silicone Glazing Work: Clean frames and glass surfaces with an approved solvent. Prime surfaces and apply structural sealant in accordance with manufacturer's recommendations. Clean excess structural sealant before curing. Mechanically hold glass firmly in place until sealant is sufficiently cured. Install compressible backer rods in joint before applying weatherseal sealant.
- F. Erection Tolerances: Install curtain wall components plumb, level, accurately aligned, and located in reference to column lines and floor levels. Erection tolerances indicated below are the maximum allowable for both no-load and full-load conditions and are not cumulative. Adjust work to conform to the following tolerances:
 - 1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.

2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment: Limit offset of member alignment to 1/16 inch where surfaces are flush or less than 1/2 inch out of flush and separated by less than 3 inches by protruding work; otherwise limit offsets to 1/8 inch.
4. Location: 3/8 inch maximum deviation from the measured theoretical location of any member at any location.

3.4 GLAZING INSTALLATION

- A. Install setting blocks of proper size in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6" from corner, unless otherwise required. Set blocks in thin course of sealant which is acceptable for heel bead use.
- B. Provide spacers inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.
- C. Provide edge blocking to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.
- D. Provide compressible filler rods or equivalent back-up material, as recommended by sealant and glass manufacturers, to prevent sealant from extruding into glass channel weep systems and from adhering to joints back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated. Force sealants into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

3.5 MIRROR INSTALLATION

- A. Do not install mirrors on new plaster, freshly painted walls, or where airborne solvents, heavy-duty cleaners, etc., are in the air. Sub-surfaces shall be allowed to cure for a minimum of 72 hours.
- B. Use exposed clips at top and continuous bottom clip at base of mirror.
- C. Seal bottom edges of mirror track with clear sanitary sealant. Refer to Section 07 92 00. Allow to dry.
- D. Apply adhesive to 60% of back of mirror.
- E. Set mirror supported by setting blocks and press against substrate to ensure bond of adhesive.
- F. Hold mirror in place until adhesive fully sets.

3.6 PROTECTION AND CLEANING

- A. Protect exterior glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.

- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less often than once a month, for build-up of dirt, scum, alkali deposits or staining. When examination reveals presence of these forms of residue, remove by method recommended by glass manufacturer.
- D. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.
- E. Wash glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion.

END OF SECTION 08 80 00 (08800)

SECTION 08 90 00 - LOUVERS AND VENTS

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. Fixed, extruded-aluminum louvers.
- B. Related Sections:
 - 1. Division 23 Sections for louvers that are a part of mechanical equipment.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on code required calculation procedures and wind loading and pressures as indicated on Structural Drawings.
- C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 as indicated on the Structural Drawings.

- D. Design earthquake spectral response acceleration, short period (Sds) for Project as indicated on the Structural Drawings.
 - 1. Component Importance Factor is 1.0.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
- F. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of metal finish required.
- E. Delegated-Design Submittal: For louvers indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Welding: If welding is indicated on the shop drawings, qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

3. AWS D1.6, "Structural Welding Code - Stainless Steel."

- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.7 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.
- D. Fasteners: Use types and sizes to suit unit installation conditions.
1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
1. Frame Type: as required to obtain appearance indicated on the drawings.

- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Nondrainable-Blade Louver:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Model AEL-42 as manufactured by Reliable Products, 1300 Enterprise Road, P.O. Box 580, Geneva, Alabama, 36340-0580 Phone: (800) 239-4621, Fax: (800) 508-1469, www.reliablelouver.com or comparable product by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Airolite Company, LLC (The).
 - c. American Warming and Ventilating, Inc.; a Mestek company.
 - d. Arrow United Industries; a division of Mestek, Inc.
 - e. Construction Specialties, Inc.
 - f. Greenheck Fan Corporation.
 - g. Nystrom Building Products.
 - h. Reliable Products, Inc.
 - i. Ruskin Company; Tomkins PLC.
- 2. Louver Depth: 1.375 inch.
- 3. Blade Profile: Plain blade without center baffle, 42 degree architectural louver.

2.4 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.5 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.
- B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089000

SECTION 09 21 16.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

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 gypsum board shaft-wall assemblies for the following:
 - 1. Shaft-wall enclosures.
 - 2. Chase enclosures.
- B. Related Sections include the following:
 - 1. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate gypsum board shaft-wall assemblies.
 - 2. Division 09 Section "Gypsum Board" for applying and finishing panels in gypsum board shaft-wall assemblies.

1.3 SUBMITTALS

- A. Product Data: For each gypsum board shaft-wall assembly indicated.

1.4 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Provide materials and construction identical to those of assemblies with fire-resistance ratings determined according to ASTM E 119 by a testing and inspecting agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

- C. Stack panels flat on leveled supports off floor or slab to prevent sagging.

1.6 PROJECT CONDITIONS

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

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. G-P Gypsum.
 - 2. National Gypsum Company.
 - 3. USG Corporation.

2.2 GYPSUM BOARD SHAFT-WALL ASSEMBLIES, GENERAL

- A. Provide materials and components complying with requirements of fire-resistance-rated assemblies indicated.
 - 1. Provide panels in maximum lengths available to eliminate or minimize end-to-end butt joints.

2.3 PANEL PRODUCTS

- A. Gypsum Liner Panels: Comply with ASTM C 442/C 442M.
 - 1. Moisture- and Mold-Resistant Type X: Manufacturer's proprietary liner panels with moisture- and mold-resistant core and surfaces; comply with ASTM D 3273.
 - a. Core: 1 inch (25.4 mm) thick.
 - b. Long Edges: Double bevel.
- B. Gypsum Board: As specified in Division 09 Section "Gypsum Board."

2.4 NON-LOAD-BEARING STEEL FRAMING

- A. Framing Members: Comply with ASTM C 754 for conditions indicated.
- B. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
 - 1. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized, unless otherwise indicated.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced product standards and manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes specified in Division 09 Section "Gypsum Board" that comply with gypsum board shaft-wall assembly manufacturer's written recommendations for application indicated.
- C. Gypsum Board Joint-Treatment Materials: As specified in Division 09 Section "Gypsum Board."
- D. Laminating Adhesive: Adhesive or joint compound recommended by manufacturer for directly adhering gypsum face-layer panels and gypsum-base face-layer panels to backing-layer panels in multilayer construction.
 - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- F. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 - 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
 - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- G. Sound Attenuation Blankets: ASTM C 665, 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.

H. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."

1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 GYPSUM BOARD SHAFT-WALL ASSEMBLIES

A. Basis-of-Design Product: As indicated on Drawings by design designation of a qualified testing agency.

B. Fire-Resistance Rating: As indicated.

C. STC Rating: As indicated.

D. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.

1. Depth: As indicated.
2. Minimum Base-Metal Thickness: 0.0359 inch (0.911 mm).

E. Runner Tracks: Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches (51 mm) long and in depth matching studs.

1. Minimum Base-Metal Thickness: 0.0359 inch (0.911 mm).

F. Firestop Tracks: Top runner 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. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dietrich Metal Framing; The System by Metal-Lite, Inc.
 - b. Fire Trak Corp.; Fire Trak.

G. Jamb Struts: Manufacturer's standard J-profile strut with long-leg length of 3 inches (76 mm), in depth matching studs, and not less than 0.0359 inch (0.911 mm) thick.

H. Room-Side Finish: Gypsum board.

I. Shaft-Side Finish: As indicated.

J. Insulation: Sound attenuation blankets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to which gypsum board shaft-wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:
 - 1. ASTM C 754 for installing steel framing except comply with framing spacing indicated.
 - 2. Division 09 Section "Gypsum Board" for applying and finishing panels.
- B. Do not bridge architectural or building expansion joints with shaft-wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.
 - 1. Where handrails directly attach to gypsum board shaft-wall assemblies, provide galvanized steel reinforcing strip with 0.0312-inch (0.79-mm) minimum thickness of base (uncoated) metal, accurately positioned and secured behind at least 1 gypsum board face-layer panel.
- D. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect, while maintaining fire-resistance rating of gypsum board shaft-wall assemblies.

- H. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3mm) from the plane formed by faces of adjacent framing.

3.3 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and 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 092116.23

SECTION 09 29 00 - GYPSUM BOARD

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-Load Bearing Interior Steel Framing
 - a. Interior Partitions
 - b. Suspended and Furred Ceilings
2. Gypsum Board, Screw-Attached to Wood Framing and Furring Members, and Required Accessories
3. Gypsum Board, Screw-Attached to Steel Framing and Furring Members, and Required Accessories
4. Glass-Mat, Mold & Mildew Resistant Interior Wall Panel
5. Tile-Backer Boards

1.2 REFERENCES

A. [American Iron and Steel Institute \(AISI\)](#) Publications:

1. "Specification for the Design of Cold Formed Steel Structural Members"

B. [ASTM International \(ASTM\)](#) Publications:

1. A510 "Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel"
2. A653 "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process"
3. A641/A641M "Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire"
4. C11 "Standard Terminology Relating to Gypsum and Related Building Materials and Systems"
5. C475 "Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board"
6. C514 "Standard Specification for Nails for the Application of Gypsum Board"
7. C557 "Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing"
8. C645 "Standard Specification for Nonstructural Steel Framing Members"
9. C754 "Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products"
10. C834 "Standard Specification for Latex Sealants"
11. C840 "Standard Specification for Application and Finishing of Gypsum Board"
12. C919 "Standard Practice for Use of Sealants in Acoustical Applications"
13. C954 "Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. to 0.112 in. in Thickness"

14. C1002 "Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs"
 15. C1047 "Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base"
 16. C1177 "Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing"
 17. C1178 "Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel"
 18. C1396 "Standard Specification for Gypsum Board"
 19. D3273 "Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber"
 20. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"
 21. E90 "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements"
 22. E119 "Standard Test Methods for Fire Tests of Building Construction and Materials"
 23. E413 "Classification for Rating Sound Insulation"
 24. E488 "Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements"
 25. E736 "Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members"
 26. E 759 "Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members"
 27. E761 "Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members"
- C. [Gypsum Association \(GA\)](#) Publications:
1. GA-214 "Recommended Levels of Gypsum Board Finish"
 2. GA-216 "Application and Finishing Of Gypsum Panel Products"
 3. GA-505 for definitions of terms for gypsum board assemblies not defined in this Section
 4. GA-600 "Fire Resistance Design Manual"
- D. [FM Global \(FMG\)](#):
1. "Approval Guide, Building Products"
- E. [Underwriters Laboratory \(UL\)](#):
1. "Fire Resistance Directory"
 2. ANSI/UL 263
 3. UL 723
- F. [United States Gypsum Co. \(USG\)](#):
1. "Gypsum Construction Handbook"

1.3 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to [ASTM](#) C11 and [GA](#)-505 for definitions of terms for gypsum board construction not otherwise defined in this Section or other referenced standards.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Submit Product Data for each type of product specified.
 - 2. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

1.5 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Where indicated, provide materials and construction which are identical to those of assemblies whose fire-resistance rating has been determined per [ASTM](#) E119 by a testing and inspecting organization acceptable to authorities having jurisdiction.
 - 1. Provide fire-resistance-rated assemblies identical to those indicated by reference to [GA](#) 600 "Fire Resistance Design Manual", to design designations in [U.L.](#) "Fire Resistance Directory", to [FMG](#)'s "Approval Guide, Building Products", or in listing of other testing and agencies acceptable to authorities having jurisdiction.
 - 2. Fire Resistance: Provide gypsum board assemblies with fire-resistance ratings indicated.
- B. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated.
- C. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.
- D. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.
- E. Sound Transmission Characteristics: For gypsum board assemblies indicated to have STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined per [ASTM](#) E90 and classified per [ASTM](#) E413 by a qualified independent testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.
 - 1. Gypsum Board Materials that have become wet before or after installation shall be removed and replaced. Re-use of wet materials that have been dried-out will not be permitted or acceptable for installation.

- C. Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions, General: Establish and maintain environmental conditions for application and finishing gypsum board to comply with [ASTM](#) C840 and with gypsum board manufacturer's recommendations, whichever are more stringent.
- B. Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg. F. For adhesive attachment and finishing of gypsum board maintain not less than 50 deg. F. for 48 hours prior to application and continuously thereafter until drying is complete. Do not exceed 95 deg. F when using temporary heat sources.
- C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.
 - 1. Provide adequate ventilation to permit drying during curing.

PART 2 PRODUCTS

2.1 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

- A. General: Provide components complying with [ASTM](#) C754 for conditions indicated.
- B. Grid Suspension System for Interior Ceilings: [ASTM](#) 645, manufacturer's standard direct-hung grid suspension system composed of main beams and cross furring members that interlock to form a modular supporting network.
- C. Wire for Hangers and Ties: [ASTM](#) A641, Class 1 Zinc Coating, Soft Temper, 0.162" diameter.
- D. Hanger Rods: [ASTM](#) A510 Mild steel and zinc coated or protected with rust-inhibitive paint.
- E. Channels: Cold-rolled steel, 0.0538-inch-minimum thickness of base (uncoated) metal and 1/2-inch-wide flanges, and as follows:
 - 1. Carrying Channels: 2 inches deep, 590 lb. per 1,000 feet, unless otherwise indicated.
 - 2. Furring Channels: 3/4 inch deep, 300 lb. per 1,000 feet, unless otherwise indicated.
 - 3. Finish: G-60 hot-dip galvanized coating per [ASTM](#) A653 for framing for toilet rooms and where indicated.
 - a. Rust-inhibitive paint, unless otherwise indicated.
- F. Steel Resilient Furring Channels: Manufacturer's standard product designed to reduce sound transmission, fabricated from steel sheet complying with [ASTM](#) A653 or [ASTM](#) A568 to form 1/2-inch deep channel of the following configuration:
 - 1. Single-Leg Configuration: Asymmetric-shaped channel with face connected to a single flange by a single-slotted leg (web) or hat-shaped channel, with 1-1/2-inch- wide face connected to flanges by double-slotted or expanded-metal legs (webs).
- G. Cast-in-Place and Post-installed Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials, with holes or loops for attaching hanger wires, and with capability to sustain, without failure, a load equal to 5 times that imposed by ceiling construction, as determined by testing according to [ASTM](#) E488 conducted by a qualified independent testing agency.
 - 1. [\[Cast-in-place type designed for attachment to concrete forms\]](#)

2. [\[Post-installed, chemical anchor\]](#)
3. [\[Post-installed expansion anchor\]](#)

2.2 GYPSUM BOARD PRODUCTS

A. Qualified Manufacturers:

1. [CertainTeed Gypsum, Inc.](#) (800-233-8990)

B. General: Provide gypsum board of types indicated in maximum lengths available that will minimize joints in each area and correspond with support system indicated.

1. Thickness: Provide gypsum board in thicknesses indicated or, if not otherwise indicated, in 1/2" thicknesses to comply with [ASTM](#) C840 for application system and support spacing indicated.

C. Gypsum Wallboard: [ASTM](#) C1396 and as follows:

1. Type: [Regular for vertical surfaces, unless otherwise indicated\]](#)
2. Type: Moisture-resistant tile backer board for use as a substrate for ceramic tile in wet areas.
3. Type: Type X [\[where required for fire-resistance-rated assemblies\]](#).
4. Type: Type C [\[where required for sound rated wall assemblies\]](#)
5. Type: Sag-resistant Type for Ceiling Surfaces
6. Edges: Tapered and Featured (rounded or beveled) for prefilling.

D. Tile-Backer Boards

1. Moisture-Resistant Gypsum Backing Board: [ASTM](#) C1178, of type and thickness indicated below:
 - a. Type and Thickness: Regular, 1/2 inch thick, unless otherwise indicated.
 - b. Type and Thickness: Type X, 5/8 inch thick, where required for fire-resistance-rated assemblies and where indicated.

2.3 TRIM ACCESSORIES

A. Accessories for Interior Installation: Corner beads, edge trim, and control joints complying with [ASTM](#) C1047 and requirements indicated below:

1. Material: Formed metal combined with paper, with metal complying with the following requirement:
 - a. Sheet steel zinc-coated by hot-dip process.
2. Shapes indicated below by reference to Fig. 1 designations in [ASTM](#) C1047:
 - a. Cornerbead on outside corners, unless otherwise indicated.
 - b. LC-bead (J-Bead) with both face and back flanges; face flange formed to receive joint compound. Use LC-beads at exposed panel edges unless otherwise indicated.
 - c. L-bead with face flange only; face flange formed to receive joint compound. Use L-bead where indicated.
 - d. U-bead with face and back flanges; face flange formed to be left without application of joint compound. Use U-bead where indicated.

- e. One-piece control joint formed with V-shaped slot, with removable strip covering slot opening. Use where indicated.
- B. Zinc Accessories for Exterior Installations: Corner beads, edge trim, and control joints formed from rolled zinc complying with [ASTM C1047](#), in shapes indicated below by reference to [ASTM C1047](#):
 1. Corner bead on outside corners, unless otherwise indicated.
 2. Shape LC-Bead (J-Bead), use at exposed panel edges, unless otherwise indicated.
 3. One-piece control joint formed with V-shaped slot, with removable strip covering slot opening. Use where indicated.

2.4 JOINT TREATMENT MATERIALS

- A. General: Provide materials complying with [ASTM C475](#), [ASTM C840](#), and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.
- B. Joint Tape: [ASTM C475](#), 2-inch nominal width, paper reinforcing tape, unless otherwise indicated.
- C. Setting-Type Joint Compounds for Gypsum Board: Factory-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated.
 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - a. Apply water resistant tile adhesive to all cut or exposed edges, utility holes, and joints including those at wall intersections.
 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.
- D. Spray-Applied Skim Coat Primer-Surfacer:
 1. Qualified Manufacturers:
 - a. [CertainTeed Gypsum, Inc.](#) (800-233-8990)

2.5 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Provide nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Latex Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with [ASTM C834](#) and the following requirements:
 1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per [ASTM E90](#).
 2. Product has flame-spread and smoke-developed ratings of less than 25 per [ASTM E84](#).

2.6 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum drywall construction which comply with referenced installation standards and the recommendations of the manufacturer of the gypsum board.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum boards to continuous substrates.
- C. Spot Grout: [ASTM](#) C475, setting-type joint compound of type recommended for spot grouting hollow metal door frames.
- D. Fastening Adhesive for Wood: [ASTM](#) C557.
- E. Fastening Adhesive for Metal: Special adhesive recommended for attaching gypsum panels to steel framing.
- F. Steel drill screws complying with [ASTM](#) C1002 for the following applications:
 - 1. Fastening gypsum board to steel members less than 0.03 inch thick.
 - 2. Fastening gypsum board to wood members.
 - 3. Fastening gypsum board to gypsum board.
- G. Steel drill screws complying with [ASTM](#) C954 for fastening gypsum board to steel members from 0.033 to 0.112 inch thick.
- H. Gypsum Board Nails: [ASTM](#) C514.
- I. Water: All water used in joint system shall be clean and free from deleterious amounts of foreign material.
- J. Other Materials: All other materials not specifically described but required for a complete and proper installation of gypsum drywall shall be as selected by the Contractor, subject to approval by the [\[Architect\]](#) [\[Owner's Representative\]](#).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates with Installer present, to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 CEILING ANCHORAGES:

- A. Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.

3.3 INSTALLING STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

- A. Screw furring members to metal framing.
- B. Suspend ceiling hangers from building 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 structural or ceiling suspension system. 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 the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure, as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 5. Do not attach hangers to steel deck tabs.
 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 7. Do not connect or suspend steel framing from ducts, pipes or conduit.
 8. Sway-brace suspended steel framing with hangers used for support.
- C. Install suspended steel framing components in sizes and at spacings indicated but not less than that required by the referenced steel framing installation standard.
1. Wire Hangers: 0.1620-inch (8-gauge) diameter, 4 feet o.c.
 2. Carrying Channels (Main Runners): 1-1/2, 4 feet o.c.
 3. Rigid Furring Channels (Furring Members): 16 inches o.c.
 4. Rigid Furring Channels (Furring Members): 24 inches o.c.
- D. Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring members or grid suspension members are level to within 1/8 inch in 12 feet as measured both lengthwise on each member and transversely between parallel members.
- E. Wire-tie or clip furring members to main runners and to other structural supports as indicated.
- F. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.4 APPLICATION AND FINISHING OF GYPSUM BOARD, GENERAL

- A. Gypsum Board Application and Finishing Standards: Install and finish gypsum board to comply with [ASTM C840](#) and [GA-216](#).
- B. Install sound attenuation blankets where indicated, prior to gypsum board unless readily installed after board has been installed on one side.
- C. Locate exposed end-butt joints as far from center of walls and ceilings as possible and stagger not less than 24 inches in alternate courses of board.

- D. Install ceiling boards across framing in the manner which minimizes the number of end-butt joints and which avoids end joints in the central area of each ceiling. Stagger end joints at least 24 inches, but not less than one framing member.
- E. Install wall/partition boards in manner which minimizes the number of end-butt joints or avoids them entirely where possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs. Gypsum boards shall extend tight to floors and ceilings with no gaps.
- F. Install exposed gypsum board with face side out. Do not install imperfect, damaged, or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.
- G. Locate either edge or end joints over supports, except in horizontal applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field-cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.
- H. Attach gypsum board to steel studs so that leading edge or end of each board is attached to open (unsupported) edge of stud flanged first.
- I. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.
- J. Form control joints and expansion joints at locations indicated, with space between edges of boards, prepared to receive trim accessories. If not shown on Drawings, control joints shall be installed as follows, in locations as approved by Architect:
 - 1. A control joint shall be installed where a partition, wall, or ceiling traverses a construction joint (expansion, seismic, or building control element) in the base building structure.
 - 2. Control joints shall be installed where a wall or partition runs in an uninterrupted straight plane exceeding 30 linear feet.
 - 3. Control joints in interior ceilings with perimeter relief shall be installed so that linear dimensions between control joints do not exceed 50 feet and total area between control joints does not exceed 2500 sq. ft.
 - 4. Control joints in interior ceilings without perimeter relief shall be installed so that linear dimensions between control joints do not exceed 30 feet and total area between control joints does not exceed 900 sq. ft.
 - 5. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.
- K. Where a control joint occurs in an acoustical or fire-rated system, blocking shall be provided behind the control joint by using a backing material consisting of 5/8" type X gypsum board.
- L. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide 1/4 inch to 1/2 inch space and trim edge with "U" bead edge trim. Seal joints with acoustical sealant.

- M. Where STC-rated gypsum board assemblies are indicated, seal construction at perimeters, control and expansion joints, openings and penetrations with a continuous bead of acoustical sealant including a bead at both faces of partitions. Comply with [ASTM C919](#) and manufacturer's recommendations for location of edge trim and close off sound-flanking paths around or through construction, including sealing of partitions above acoustical ceilings.
- N. Space fasteners in gypsum boards in accordance with referenced gypsum board application and finishing standard and manufacturer's recommendations.

3.5 GYPSUM BOARD APPLICATION METHODS

- A. Single-Layer Application: Install gypsum wallboard as follows:
 - 1. On ceilings, apply gypsum board prior to wall/partition board application to the greatest extent possible, and at right angles to framing, unless noted otherwise.
 - 2. On partitions/walls, apply gypsum board vertically (parallel to framing), unless otherwise indicated, and provide sheet lengths which will minimize end joints.
 - 3. On Z-furring members, apply gypsum board vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
- B. Multi-layer Application: Install gypsum backing board for base layer and gypsum wallboard for face layer.
 - 1. On ceilings, apply base layer prior to applying base layer on walls/partitions; apply face layers in same sequence. Offset face-layer joints one framing member, but not less than 16 inches from parallel base-layer joints. Apply base layers at right angles to framing members unless otherwise indicated.
 - 2. On partitions/wall, apply base layer and face layers vertically (parallel to framing) with joints of base layer over supports and face layer joints offset at least, one stud or furring member, not less than 10 inches with base layer joints.
 - 3. On Z-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.
- C. Single-Layer Fastening Methods: Apply gypsum boards to supports with steel drill screws.
- D. Multi-Layer Fastening Methods: Apply base layer of gypsum board and face layer to base layer as follows:
 - 1. Fasten both base layers and face layers separately to supports with screws.
- E. Direct-Bonding (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 recommendations, and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- F. Install gypsum wallboard panels with tapered edges taped and finished to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.
- G. Wall Tile Substrates: For substrates indicated to receive thin-set ceramic tile and similar rigid applied wall finishes, comply with the following:
 - 1. Install water-resistant Tile-Backer Board panels at [\[all areas\]](#) [\[showers, tubs, and where indicated\]](#) to receive tile.

2. Tile Backing Panels:

- a. Moisture-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at [\[showers, tubs, and where indicated\]](#) [\[locations indicated to receive tile\]](#). Install with ¼ inch gap where panels abut other construction or penetrations.
- b. Areas Not Subject to Wetting: Install standard gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations to receive water-resistant panels.
- c. Where tile backing panels abut other types of panels in the same plane, shim surface to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES

- A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges to comply with manufacturer's recommendations.
- B. Install corner beads at external corners.
- C. Install edge trim where edge of gypsum panels would otherwise be exposed or semi-exposed. Provide edge trim type with face flange formed to receive joint compound except where other types are indicated.
- D. Install edge trim where edge of gypsum board would otherwise be exposed or semi-exposed. Provide edge trim-type with face flange to receive joint compound except where other types are indicated.
 1. Install "LC" bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
 2. Install "L" bead where edge trim can only be installed after gypsum board is installed.
 3. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).

3.7 FINISHING OF GYPSUM BOARD ASSEMBLIES

- A. General: Apply joint treatment at gypsum board joints (both directions), flanges of corner bead, edge trim, and control joints, penetrations, fastener heads, surface defects and elsewhere as required to prepare work for decoration and level of gypsum board finish indicated.
 1. Prefill open joints, rounded or beveled edges, and damaged areas, using setting-type joint compound.
 2. Apply joint tape over gypsum board joints except those with trim accessories having concealed face flanges not requiring taping to prevent cracks from developing in joint treatment at flange edges.
- B. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per [GA-214](#).
 1. Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistive-rated assemblies and sound-rated assemblies.
 2. Level 2 where water-resistant gypsum backing board panels form substrates for tile, and where indicated.

3. Level 4 for gypsum board surfaces indicated to receive light-textured finishes, wallcoverings, and flat paints over light textures.
4. Level 4 for gypsum board surfaces indicated to receive gloss and semi-gloss enamels, nontextured flat paints, and where indicated.
- C. For Level 4 gypsum board finish, embed tape in finishing compound plus two separate coats applied over joints, angles, fastener heads, and trim accessories using one of the following combinations of joint compounds (not including prefill), and sand between coats and after last coat.
- D. Where Level 2 gypsum board finish is indicated, apply joint specified for first coat in addition to embedding coat.
- E. Where Level 1 gypsum board finish is indicated, apply joint compound specified for embedding coat.
- F. Allow not less than 24 hours drying time between coats.
- G. Glass-Mat Gypsum Interior Wall Panel:
 1. Finish according to manufacturer's written instructions for use in interior applications.

3.8 ADJUST AND CLEAN

- A. Cut, patch, repair, and point-up gypsum board as required. Repair cracks and indented surfaces.
- B. Clean spilled or splattered materials from adjacent surfaces not to be coated, immediately before coating has achieved an initial set. Do not scratch or damage adjacent finished surfaces. Repair floors, walls, and other surfaces which have been stained, marred, or otherwise damaged during the framing and gypsum board work. Daily remove unused materials, containers, and equipment. Clean floors of all gypsum board and wood debris and leave broom clean.

3.9 PROTECTION

- A. Provide final protection and maintain conditions, in a manner suitable to installer, which ensures gypsum drywall construction being without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 21 16 (09255)

SECTION 09 30 13 - CERAMIC TILE

PART 1 PRODUCTS

1.1 SUMMARY

- A. Section Includes:
 - 1. Floor and Wall Tile and Accessories
 - 2. Leveling Coat, Mortar, Grouts, and Adhesives
 - 3. Shower Pan Liners
 - 4. Thresholds

1.2 REFERENCES

- A. [Tile Council of North America, Inc. \(TCA\)](#):
 - 1. "Hand Book for Ceramic Tile Installation"
- B. [American National Standards Institute \(ANSI\)](#)
 - 1. "American Standard Specification for the Installation of Ceramic Tile"
 - 2. A108.5 - Ceramic Tile Installed with Dry-Set Portland Cement Mortar.
 - 3. A108.6 - Specifications for Ceramic Tile Installed with Chemical-Resistant, Water-Cleanable Tile-Setting and -Grouting Epoxy
 - 4. A108.10 - Specifications for Installation of Grout in Tilework.
 - 5. A118 - Latex-Portland Cement Mortar4
 - 6. A118.1 - Dry-Set Portland Cement Mortar
 - 7. A118.3 - Chemical-Resistant, Water-Cleanable, Tile-Setting and -Grouting Epoxy and Water-Cleanable Tile-Setting Epoxy Adhesive
 - 8. A118.4 – "Latex-Portland Cement Mortar"
 - 9. A118.7 – "Polymer Modified Cement Grouts"
 - 10. A136.1 - Organic Adhesives for Installation of Ceramic Tile
 - 11. A137.1 - Recommended Standard Specifications for Ceramic Tile
- C. [ASTM International](#) Publications:
 - 1. C241 "Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic"
 - 2. C503 "Standard Specification for Marble Dimension Stone (Exterior)"
 - 3. C627 "Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester"
 - 4. C1028 "Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method"

1.3 SUBMITTALS

- A. General: Submit in accordance with Conditions of Contract and Division 01 Specification Sections.

1.4 QUALITY ASSURANCE

- A. In addition to complying with all pertinent codes and regulations, conform to [ANSI](#) - American Standard Specification for the Installation of Ceramic Tile.
- B. A single manufacturer shall produce all tiles and accessories.
- C. Performance Requirements:
 - 1. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per [ASTM](#) C1028:
 - a. All horizontal Surfaces: Minimum 0.6 Wet
 - b. Step Treads: Minimum 0.6. Wet

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver packaged materials and store in original containers with seals unbroken and labels intact until time of use in accordance with manufacturer's directions. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.
- B. Comply with [ANSI](#) A137.1 for labeling sealed tile packages.
- C. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.6 PROJECT CONDITIONS

- A. Substrate shall be prepared to receive new tile in a manner acceptable to the tile manufacturer. Existing flooring and other materials shall be removed and surface prepared to accept new tile.
- B. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to one case for each type, composition, color, pattern, and size indicated.

PART 2 PRODUCTS

2.1 FLOOR AND WALL TILE

- A. Qualified Manufacturers:
 - 1. [Dal-Tile](#) (800-933-Tile)
- B. Floor Tile: [\[Hampton Inn & Suites Interior Finish Specifications\]](#)
- C. Wall Tile: [\[Hampton Inn & Suites Interior Finish Specifications\]](#)
- D. Tile Base and Accessories: Provide special shapes such as bull-nose edges and other accessories as required, to match wall tile.
 - 1. Provide matching bull-nose tile at all exposed edges.

2.2 LEVELING COAT

- A. Leveling coat shall be 1/4" thick or less and shall consist of dry set mortar to which an equal volume of a mixture of one part Portland Cement and 1-1/2 parts sand has been added.
- B. Maximum variation in surface of leveling coat shall not exceed 1/8" in 8'-0" from required plane.
- C. Leveling coat shall be cured at least 24 hours before tile is applied.
- D. Surface to which leveling coat is to be applied shall be free of any coatings, oil, and wax.

2.3 MORTAR MATERIALS: FLOOR TILE

- A. Bond Coat: Thin Set Mortar with Polymer or Acrylic/Latex Additive
- B. Installation conforming to [ANSI](#) A108.6 and A118.4 and Tile Council of America Handbook for Ceramic Tile Installation No. F122 and TR911.

2.4 WALL ADHESIVE MATERIALS - CERAMIC TILE

- A. High strength latex-based, non-flammable adhesive formulated to meet or exceed the requirements of [ANSI](#) A136.1, Type 1.

2.5 GROUT MATERIALS

- A. Latex Portland Cement Grout consisting of dry set mortar with an acrylic latex or polymer epoxy additive. Use in conformance with [ANSI](#) A108.5 and [ANSI](#) A108.10. Materials shall conform to [ANSI](#) A118.3 and [ANSI](#) A118.7.
- B. Water-Cleanable Epoxy Grout: [ANSI](#) A118.3
 - 1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F (60 deg C) and 212 deg F (100 deg C), respectively, and certified by manufacturer for intended use.

2.6 THRESHOLDS

- A. Georgia Marble, complying with [ASTM](#) C503 requirements, Grade A, free from cracks, chips, stains, or other defects, uniform in tone and coloring. Minimum abrasive-hardness value of 10 per [ASTM](#) C241. Finish to be fine sand-honed on faces and beveled edges.
- B. Color and size as shown in [\[Hampton Inn & Suites Interior Finish Specifications\]](#).

2.7 ACCESSORIES

- A. Edging and Transition Strips for floor tile:
 - 1. Miter corners and angles. Install in longest lengths possible with closely fitted and aligned butt joints, and with horizontal leg keyed into the mortar bed. Top edge shall be set flush with finished floor tile. Clean and remove any mortar stains.
 - 2. Refer to [\[Hampton Inn & Suites Interior Finish Specifications\]](#) for model, material and color.

2.8 OTHER MATERIALS:

- A. Other materials, including adhesives not specifically described but required for a complete and proper installation of tiles, shall be only as recommended by the manufacturer of material to which it is applied.

2.9 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 INSPECTION:

- A. Installer must examine the areas and conditions under which flooring and accessories are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.2 PREPARATION:

- A. Prior to laying flooring, vacuum and remove all contaminants from surfaces to be covered and inspect subfloor. Start of flooring installation indicates acceptance of subfloor conditions and full responsibility for completed work. Use leveling compound as recommended by flooring manufacturer for filling small cracks and depressions in subfloors.
- B. Apply concrete slab primer for ceramic tile, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

3.3 CRACK BRIDGING MEMBRANE

- A. Install membrane in strict accordance with manufacturer's specifications.
- B. Provide 12 inch wide strip at all control joints and existing cracks in concrete floor.

3.4 TILE INSTALLATION - GENERAL

- A. Comply with the [ANSI](#) Standard Installation Specification A108.1 through A108.13 and [TCA](#)'s "Handbook for Ceramic Tile Installation".
- B. Handle, store, mix, and apply mortar and grout in compliance with manufacturer's instructions.
- C. Extend tile work into recesses and under equipment and fixtures to form a complete covering without interruptions. Terminate work neatly at obstructions, edges, and corners without disruption of pattern or joint alignment.
- D. Install tile after finishing operations, including painting, have been completed. Moisture content of concrete slabs, building air temperature, and relative humidity must be within limits recommended by the flooring manufacturer.
- E. Lay tile from center marks established from center of area so that tile at opposing edges of the area are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at edge perimeters. Lay tile square to room axis unless otherwise shown.
- F. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged. Cut tile neatly in and around all fixtures. Broken, cracked, chipped, or deformed tile are not acceptable.

- G. Lay tile with grain in tile running in same direction. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Grind cut edges of tile abutting trim, finish, or built-in items.
- H. Sound tile after setting and replace hollow sounding units.
- I. Grout tile to comply with the requirements of the following tile installation standards:
 - 1. For ceramic tile grouts (sand-portland cement, dry-set, commercial portland cement, and latex-portland cement grouts), comply with [ANSI](#) A108.10.

3.5 SHOWER FLOOR PAN LINER INSTALLATION

- A. Install materials as directed by manufacturer to provide a concealed waterproof membrane. All seams shall be adhered to prevent delamination as specified by manufacturer. Upon completion, test for leaks by plugging the drain and filling with water. Make necessary adjustments to stop all leakage and retest until watertight, before top layers are installed.

3.6 FLOOR TILE INSTALLATION

- A. General: Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing [TCA](#) installation methods and [ANSI](#) A108 series of tile installation standards.
- B. Back Buttering: For installations indicated, obtain 100% mortar coverage by complying with applicable special requirements for back buttering of tile in referenced [ANSI](#) A108 series of tile installation standards:
 - 1. Tile floors in wet areas, including showers, tub enclosures and laundries.
 - 2. Tile floors composed of tiles 8"x 8" or larger.
 - 3. Tile floors composed of rib-backed tiles.
- C. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
- D. Metal Edge Strips: Install at locations indicated or at all locations where exposed edge of tile flooring meets carpet, wood, or other flooring, unless otherwise indicated.

3.7 WALL TILE INSTALLATION

- A. Install types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing [TCA](#) installation methods and [ANSI](#) setting-bed standards.
- B. Back Buttering: For installations indicated, obtain 100% mortar coverage by complying with applicable special requirements for back buttering of tile in referenced [ANSI](#) A108 series of tile installation standards:
 - 1. Exterior tile wall installations.
 - 2. Tile wall installations in wet areas, including showers, tub enclosures, laundries, and swimming pools.
 - 3. Tile wall installations composed of tiles 8"x 8" or larger.

3.8 ADJUST AND CLEAN

- A. Clean grout and setting material from face of tile while materials are workable. Leave tile face clean and free of all foreign matter.

- B. Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective work.
- C. Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed surface. Protect installed tile work with Kraft paper or other heavy covering during the construction period to prevent damage. Prohibit all foot and wheel traffic from using tiled floors for at least 3 days, preferably 7 days.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from all tile surfaces.

END OF SECTION 09 30 13 (09310)

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Drawn to scale and coordinating acoustical panel ceiling installation with hanger attachment to building structure and ceiling mounted items:
- C. Product test reports.
- D. Research/evaluation reports.
- E. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.
- B. Fire-Test-Response Characteristics:
 - 1. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class [A] [B] [C] materials, when tested per ASTM E 84.
 - a. Smoke-Developed Index: 450 or less.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANEL CEILINGS, GENERAL

- A. Acoustical Panel Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
- C. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, 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. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Armstrong World Industries, Inc.;
 - 2. BPB USA;
 - 3. Chicago Metallic Corporation;
 - 4. Ecophon CertainTeed, Inc.;
 - 5. Tectum Inc.;
 - 6. USG Interiors, Inc.;
- B. Color: As selected from manufacturer's full range
- C. Edge/Joint Detail: [Square] [Reveal sized to fit flange of exposed suspension system members] [Flush reveal sized to fit flange of exposed suspension system members] [Beveled, kerfed and rabbeted] <Insert manufacturer's special proprietary edge detail>.
- D. Thickness: 3/4 inch
- E. Modular Size: 24 by 24 inches

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Products: provide product from the same manufacturer as the acoustical panels indicated in section 2.2

- B. Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than **G30 (Z90)** coating designation, with prefinished [**15/16-inch- (24-mm-)**] [**9/16-inch- (15-mm-)**] wide metal caps on flanges.
1. Structural Classification: Intermediate duty system.
 2. End Condition of Cross Runners: Butt-edge type.
 3. Cap Material: Steel or aluminum cold-rolled sheet.
 4. Cap Finish: Painted to match color of acoustical unit

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with [ASTM C 636] [UBC Standard 25-2] and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders.
- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. 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.
1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
 2. Do not attach hangers to steel deck tabs
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to substrate at intervals not more than **16 inches (400 mm)** o.c. and not more than **3 inches (75 mm)** from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet (3.2 mm in 3.6 m)**. Miter corners accurately and connect securely.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

END OF SECTION 095113

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient Base
2. Transition Edges
3. Stair Nosings

1.2 REFERENCES

A. [ASTM International](#) Publications:

1. C241 "Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic"
2. C503 "Standard Specification for Marble Dimension Stone (Exterior)"
3. D2047 "Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine"
4. D2240 "Standard Test Method for Rubber Property—Durometer Hardness"
5. D3389 "Standard Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform, Double-Head Abrader)"
6. E648/NFPA 253 "Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source"
7. E662/NFPA 258 "Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials"
8. F710 "Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring"

B. [Carpet & Rug Institute \(CRI\)](#)

1. Standard for Installation of Commercial Carpet [CRI](#) 104, Current Edition

C. [Code of Federal Regulations \(CFR\)](#)

1. 40 [CFR](#) 763 - Asbestos: Appendix A - Transmission Electron Microscopy Analytical Methods

D. [Occupational Safety & Health Administration \(OSHA\)](#) Regulations:

1. [OSHA](#) Regulation 29 [CFR](#) Toxic and Hazardous Substances 1910-1200 Hazard Communication

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:

1. Submit manufacturer's product and maintenance data for each type of resilient flooring and accessory.
 - a. Certification by resilient flooring manufacturer that products supplied for flooring installation comply with local regulations controlling use of volatile organic compounds (VOCs).

2. Submit color selection in the form of actual sections of resilient flooring, including accessories, for each type of resilient flooring required showing full range of colors and patterns available.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Flooring: Obtain each type, color and pattern of flooring from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the work..
- B. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per [ASTM](#) E648.
 2. Smoke Density: Maximum specific optical density of 450 or less when tested per [ASTM](#) E662.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver tiles and installation accessories to Project site in original manufacturer's unopened cartons and containers each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store flooring materials in dry spaces protected from the weather with ambient temperatures maintained between 50 degrees F. and 90 degrees F. Store tile flooring materials on flat surfaces. Move resilient flooring and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.

1.6 PROJECT CONDITIONS

- A. Maintain a minimum temperature of 70 degrees F. in spaces to receive tiles for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less than 55 degrees F.
- B. Do not install resilient flooring until they are at the same temperature as the space where they are to be installed. Close spaces to traffic during resilient flooring installation.

1.7 SEQUENCING AND SCHEDULING

- A. Do not install resilient flooring materials over concrete slabs until the slabs have cured and are sufficiently dry to bond with adhesive as determined by tile manufacturer's recommended bond and moisture test.

1.8 EXTRA MATERIALS

- A. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
 1. Furnish not less than one box of each class, wearing surface, color, pattern, and size of resilient floor tile installed.

PART 2 PRODUCTS

2.1 RESILIENT BASE

- A. Resilient bases shall be size as shown in [\[Hampton Inn & Suites Interior Finish Specifications\]](#). Provide cove type at sheet vinyl, resilient tile flooring, and other hard surfaces. Job mitering of corners will not be permitted.

2.2 TRANSITION EDGES:

- A. Model, Size and Color: Refer to [\[Hampton Inn & Suites Interior Finish Specifications\]](#).
- B. Furnish transition edges at the following locations:
 - 1. Vinyl Composition Tile to Concrete
 - 2. Vinyl Composition Tile to Carpet
 - 3. Sheet Vinyl Flooring to Concrete
 - 4. Sheet Vinyl Flooring to Carpet
 - 5. Carpet to Carpet (Where thickness varies)
 - 6. Carpet to Ceramic Tile

2.3 RESILIENT STAIR ACCESSORIES

- A. Stair Nosings:
- B. Model, Size and Color: Refer to [\[Hampton Inn & Suites Interior Finish Specifications\]](#).

2.4 INSTALLATION ACCESSORIES

- A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.
- B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by tile manufacturer for applications indicated.
- C. Resilient Base Adhesives to be Non-Toxic, Low Odor, and Solvent Free with no alcohol, glycol, or ammonia. Adhesive shall be antimicrobial with no hazardous vapors and contain no carcinogenic materials, per OSHA Regulation 29 [CFR](#) 1910-1200. All containers shall contain material safety data sheets (MSDS) and be available at job site for inspection..
- D. Other materials, including edge strips not specifically described, but required for a complete and proper installation of resilient flooring, shall be only as recommended by the manufacturer of material to which it is applied.

PART 3 EXECUTION

3.1 INSPECTION:

- A. Installer must examine the areas and conditions under which resilient flooring and accessories are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
 - 1. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
 - 2. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

3.2 CONCRETE SUBFLOORS OR GYPSUM CEMENT FLOOR UNDERLAYMENT:

- A. Verify that concrete slabs comply with [ASTM](#) F710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, residual adhesives, adhesive removers, and other materials whose presence would interfere with

bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by manufacturer.

2. Finishes of subfloors comply with tolerances and other requirements specified in Division 03 Section, "Cast-In-Place Concrete" for slabs receiving resilient flooring.
3. Subfloor Moisture Conditions: Before installing flooring Contractor shall verify that Moisture emission rate of not more than 3 lb/1000 sq. ft./24 hours when tested by calcium chloride moisture test in compliance with [CRI](#) 104, 6.2.1, with subfloor temperatures not less than 55 deg F, or as recommended by manufacturer.
4. Subfloor Alkalinity Conditions: Before installing flooring Contractor shall verify that a pH range of 5 to 9 when subfloor is wetted with potable water and pHydron paper is applied

3.3 PREPARATION

- A. General: Comply with manufacturer's installation specifications for preparing substrates to receive products indicated.
- B. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. This Contractor to remove coatings, including curing compounds, adhesives, plastics, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush. Surface to receive new flooring shall be prepared, including removal of existing materials not acceptable for proper installation of new materials, as required by manufacturer. Do not use solvents.
 1. Prep floor according to [ASTM](#) F710 criteria.
- D. Use leveling compound as recommended by flooring manufacturer for filling small cracks and depressions in subfloors.
- E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

3.4 INSTALLATION - GENERAL:

- A. Install flooring after finishing operations, including painting, have been completed. Moisture content of concrete slabs, building air temperature, and relative humidity must be within limits recommended by flooring manufacturer's directions.
- B. Patch and repair floors and walls to receive flooring for proper installation of flooring, stair accessories, and base.
- C. Place flooring with adhesive cement in strict compliance with manufacturer's recommendations. Butt tightly to vertical surfaces and edgings. Scribe around obstructions and to produce neat joints, laid tight, even, and straight. Extend flooring into toe spaces.
- D. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent marking device.
- E. Install flooring on covers for telephone and electrical ducts and other such items as occur within finished floor areas.

- F. Maintain overall continuity of color and pattern with pieces of flooring installed in these covers. Tightly cement edges to perimeter of floor around covers and to covers.
- G. Tightly cement flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections.

3.5 RESILIENT WALL BASE INSTALLATION

- A. At areas where base is required, apply resilient base to walls, columns, pilasters, casework, and other permanent fixtures, as coordinated with type of flooring. Install base in as long lengths as practicable. Tightly bond base to backing throughout the length of each piece with continuous contact at horizontal and vertical surfaces. On irregular surfaces, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
- B. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.6 ACCESSORIES:

- A. Place resilient edge strips tightly butted to adjacent materials of type indicated and bond to substrates with adhesive. Install edging strips at all unprotected edges of flooring unless otherwise shown. Apply resilient accessories to stairs and risers as indicated and according to manufacturer's installation instructions.
- B. Stair Nosings:
 - 1. Use stair-tread-nose filler, according to resilient tread manufacturer's written instructions, to fill nosing substrates that do not conform to tread contours.
 - 2. Apply resilient products to stairs as indicated and according to manufacturer's written installation instructions.

3.7 CLEANING AND PROTECTION:

- A. Perform the following operations immediately after installing resilient floor coverings:
 - 1. Remove adhesive and other surface blemishes using cleaner recommended by floor covering manufacturer.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash floor covering until after time period recommended by floor covering manufacturer.
 - 4. Damp-mop floor to remove marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by manufacturer of resilient product involved.

- C. Clean products specified in this Section not more than four days prior to dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products using method recommended by manufacturer. Strip protective floor polish that was applied after completing installation, prior to cleaning.
- D. Do not move heavy and sharp objects directly over resilient floor coverings. Place plywood or hardboard panels over floor coverings and under objects while they are being moved. Slide or roll objects over panels without moving panels.

3.8 FINISHING:

- A. After completion of project and just prior to final inspection of work, thoroughly clean floors and accessories. For resilient tile, apply wax and buff with type of wax, number of coats, and buffing procedures in compliance with flooring manufacturer's instructions.

END OF SECTION 09 65 13.33 (09655)

SECTION 09 65 16 - RESILIENT SHEET FLOORING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient Sheet Flooring
 - a. All seams heat-welded.

1.2 REFERENCES

A. Americans with Disabilities Act ([ADA](#)) II Public Accommodations

1. [Americans with Disabilities Act Accessibility Guidelines \(ADAAG\)](#)

B. [ASTM International](#) Publications:

1. D2047 "Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine"
2. E648/NFPA 253 "Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source"
3. E662/NFPA 258 "Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials"
4. F693 "Sealing Seams of Resilient Sheet Flooring Products by Use of Liquid Seam Sealers"
5. F710 "Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring"
6. F1482 "Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring"
7. F1516 "Sealing Seams of Resilient Flooring Products by the Heat Weld Method"
8. F1869 "Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride"
9. F2170 "Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes"

C. [Code of Federal Regulations \(CFR\)](#)

1. 40 [CFR](#) 763 - Asbestos: Appendix A - Transmission Electron Microscopy Analytical Methods

D. [Occupational Safety & Health Administration \(OSHA\)](#) Regulations:

1. [OSHA](#) Regulation 29 [CFR](#) Toxic and Hazardous Substances 1910-1200 Hazard Communication

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:

1. Submit product data, including manufacturer's information and manufacturer's installation and maintenance instructions for specified products.

- a. Certification by resilient flooring manufacturer that products supplied for flooring installation comply with local regulations controlling use of volatile organic compounds (VOCS).
2. Submit shop drawings showing layout, profiles and product components, including drain details, accessories, finish colors, patterns and textures.
3. Submit color selection in the form of actual sections of resilient flooring, including accessories, for each type of resilient flooring required showing full range of colors, patterns and textures available. Submit samples for selection and verification.
 - a. Submit duplicate 12" x 12" sample pieces of sheet material, 12" long cap strip, joint cover strip & cove former.
4. Quality Assurance Submittals: Submit the following:
 - a. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
5. Closeout Submittals: Submit the following:
 - a. Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Flooring: Obtain each type, color and pattern of flooring from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the work.
- B. Installer Qualifications: Installer: A firm with not less than five years of successful experience in installation of sheet vinyl flooring systems with chemically welded seams similar to those required for this project and which is certified by manufacturer of the sheet vinyl materials.
- C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per [ASTM E648](#).
 2. Smoke Density: Maximum specific optical density of 450 or less when tested per [ASTM E662](#).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Deliver sheet vinyl floor coverings and installation accessories to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, project identification, and shipping and handling instructions.
- C. Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer. Store rolls upright and in dry locations.
 1. Store flooring materials in dry spaces protected from the weather with ambient temperatures maintained between 65 degrees F. and 80 degrees F. Move resilient

flooring and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.

1.6 PROJECT CONDITIONS

- A. Maintain a minimum temperature of 65 degrees F. in spaces to receive tiles for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less than 60 degrees F.
- B. Do not install resilient flooring until they are at the same temperature as the space where they are to be installed. Close spaces to traffic during resilient flooring installation.
 - 1. The room temperature must not be below 65F and the floor temperature 50F.
- C. Install sheet vinyl floor coverings and accessories after other finishing operations, including painting, have been completed.
- D. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances.

1.7 SEQUENCING AND SCHEDULING

- A. Do not install resilient flooring materials over concrete slabs until the slabs have cured and are sufficiently dry to bond with adhesive as determined by tile manufacturer's recommended bond and moisture test.

1.8 EXTRA MATERIALS

- A. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.

PART 2 PRODUCTS

2.1 RESILIENT SHEET VINYL:

- A. Product, Size and Color:
 - 1. Refer to [\[Hampton Inn & Suites Interior Finish Specifications\]](#).

2.2 TRANSITION EDGES:

- A. Refer to Section 09 65 00.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by floor covering manufacturer for applications indicated.
- B. Concrete Leveling and Patching compounds:
 - 1. For areas up to 4 square feet:
 - a. Feather finish, use to smooth ridges, fill cracks, gouges and joints.
 - b. Trowelable underlayment patch for thickness up to ½ inch without aggregate; up to 1 inch with aggregate. Can be feather edged.
 - 2. For areas exceeding 4 square feet:
 - a. Self-leveling, pourable or pumpable underlayment for thicknesses up to 5 inches. Can be feather edged.

- C. Adhesives: Water-resistant type recommended by manufacturer to suit sheet vinyl floor covering and substrate conditions indicated.
- D. Heat-Welding Bead: Solid-strand product of floor covering manufacturer for heat-welding seams, color to match sheet vinyl floor covering.
- E. Sealing Compound: For use where flooring meets floor mat frames, wall surfaces and where flooring is cut around pipes and penetrations.

PART 3 EXECUTION

3.1 EXAMINATION:

- A. Installer must examine the areas and conditions under which resilient flooring and accessories are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
 - 1. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
 - 2. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

3.2 CONCRETE SUBFLOORS OR GYPSUM CEMENT FLOOR UNDERLAYMENT:

- A. Verify that concrete slabs comply with [ASTM](#) F710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, residual adhesives, adhesive removers, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by manufacturer.
 - 2. Finishes of subfloors comply with tolerances and other requirements specified in Division 03 Section, "Cast-In-Place Concrete" for slabs receiving resilient flooring.
 - 3. Subfloor Moisture Conditions: Before installing flooring Contractor shall verify that Moisture emission rate of not more than 3 lb/1000 sq. ft./24 hours when tested by calcium chloride moisture test in compliance with [CRI](#) 104, 6.2.1, with subfloor temperatures not less than 55 deg F, or as recommended by manufacturer.
 - 4. Subfloor Alkalinity Conditions: Before installing flooring Contractor shall verify that a pH range of 5 to 9 when subfloor is wetted with potable water and pHydron paper is applied

3.3 PREPARATION

- A. General: Comply with manufacturer's installation specifications for preparing substrates to receive products indicated.
- B. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

- C. This Contractor to remove coatings, including curing compounds, adhesives, plastics, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush. Surface to receive new flooring shall be prepared, including removal of existing materials not acceptable for proper installation of new materials, as required by manufacturer. Do not use solvents.
 - 1. Prep floor according to [ASTM](#) F710 criteria.
- D. Use leveling compound as recommended by flooring manufacturer for filling small cracks and depressions in subfloors.
- E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

3.4 INSTALLATION - GENERAL:

- A. Install flooring after finishing operations, including painting, have been completed. Moisture content of concrete slabs, building air temperature, and relative humidity must be within limits recommended by flooring manufacturer's directions.
- B. Patch and repair floors and walls to receive flooring for proper installation of flooring, stair accessories, and base.
- C. Place flooring with adhesive cement in strict compliance with manufacturer's recommendations. Butt tightly to vertical surfaces and edgings. Scribe around obstructions and to produce neat joints, laid tight, even, and straight. Extend flooring into toe spaces.
- D. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent marking device.
- E. Install flooring on covers for telephone and electrical ducts and other such items as occur within finished floor areas.
- F. Maintain overall continuity of color and pattern with pieces of flooring installed in these covers. Tightly cement edges to perimeter of floor around covers and to covers.
- G. Tightly cement flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections.

3.5 INSTALLATION - SHEET VINYL FLOORING:

- A. General: Comply with sheet vinyl floor covering manufacturer's written installation instructions.
- B. Unroll sheet vinyl floor coverings and allow them to stabilize before cutting and fitting, if recommended in writing by manufacturer.
- C. Lay out sheet vinyl floor coverings to comply with the following requirements:
 - 1. Maintain uniformity of sheet vinyl floor covering direction.
 - 2. Arrange for a minimum number of seams and place them in inconspicuous and low-traffic areas, and not less than 6 inches away from parallel joints in flooring substrates.
 - 3. Match edges of sheet vinyl floor coverings for color shading and pattern at sump according to manufacturer's written recommendations.
 - 4. Avoid cross seams.

- D. Install flooring wall-to-wall before the installation of floor-set cabinets, casework, furniture, equipment, moveable partitions and similar moveable objects.
- E. Scribe, cut, and fit or flash cove to permanent fixtures, built-in furniture and cabinets, pipes and outlets, and permanent columns, walls, and partitions as shown on Drawings.
- F. Extend sheet vinyl floor coverings into toe spaces, door reveals, closets, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, nonstaining marking device.
- H. Install sheet vinyl floor coverings on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on covers. Tightly adhere edges to perimeter of floor around covers and to covers.
- I. Adhere sheet vinyl floor coverings to flooring substrates to comply with floor covering manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 1. Produce completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
 - 2. Form integral flash cove base by flashing floor covering up vertical surfaces. Support floor covering at horizontal and vertical junction with cove strip. Butt floor covering at top of base against cap strip.
- J. Heat-Welded Seams: Rout joints and heat weld with welding bead, permanently fusing sections into a seamless floor covering. Prepare, weld, and finish seams according to manufacturer's written instructions and [ASTM F1516](#) to produce surfaces flush with adjoining floor covering surfaces.
- K. Hand roll sheet vinyl floor coverings in both directions from center out to embed floor coverings in adhesive and eliminate trapped air. At walls, door casings, and other locations where access by roller is impractical, press floor coverings firmly in place with flat-bladed instrument.
- L. At locations not shown to receive integral flash cove base, install continuous bead of clear sanitary silicone sealant at all perimeters before installing resilient cove base. Sealant shall be approved by sheet vinyl manufacturer.

3.6 CLEANING AND PROTECTION:

- A. Perform the following operations immediately after installing resilient floor coverings:
 - 1. Remove adhesive and other surface blemishes using cleaner recommended by floor covering manufacturer.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash floor covering until after time period recommended by floor covering manufacturer.
 - 4. Damp-mop floor to remove marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by manufacturer of resilient product involved.

- C. Clean products specified in this Section not more than four days prior to dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products using method recommended by manufacturer. Strip protective floor polish that was applied after completing installation, prior to cleaning.
- D. Do not move heavy and sharp objects directly over resilient floor coverings. Place plywood or hardboard panels over floor coverings and under objects while they are being moved. Slide or roll objects over panels without moving panels.
- E. Cover sheet vinyl floor coverings with undyed, untreated building paper until inspection for Substantial Completion.
- F. After completion of project and just prior to final inspection of work, thoroughly clean floors and accessories.

END OF SECTION 09 65 16 (09652)

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid vinyl floor tile.
2. Rubber floor tile.
3. Vinyl composition floor tile.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.

C. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

D. Samples: Full-size units of each color and pattern of floor tile required.

E. Maintenance data.

1.3 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.

1.4 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive floor tile.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 SOLID VINYL FLOOR TILE <Insert drawing designation>

- A. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
1. Altro Group; <Insert product name or designation>.
 2. Amtico Studio (The), Amtico International Inc.; <Insert product name or designation>.
 3. Armstrong World Industries, Inc.; <Insert product name or designation>.
 4. Burke Mercer Flooring Products, Division of Burke Industries Inc.; <Insert product name or designation>.
 5. Estrie Products International, American Biltrite (Canada) Ltd.; <Insert product name or designation>.
 6. Flexco; <Insert product name or designation>.
 7. Gemtec Inc.; <Insert product name or designation>.
 8. Gerflor, Architectural Floor Systems, Inc.; <Insert product name or designation>.
 9. Johnsonite; <Insert product name or designation>.
 10. Polyflor, Ltd., Distributed by Gerbert Limited; <Insert product name or designation>.
 11. Roppe Corporation, USA; <Insert product name or designation>.
 12. Tarkett, Inc.; <Insert product name or designation>.
 13. TOLI International; <Insert product name or designation>.
 14. VPI, LLC, Floor Products Division; <Insert product name or designation>.
 15. <Insert manufacturer's name; product name or designation>.
- B. Tile Standard: ASTM F 1700.
1. Class: [As indicated by product designations] [Class I, monolithic vinyl tile] [Class II, surface-decorated vinyl tile] [Class III, printed film vinyl tile].
 2. Type: [Type A, smooth surface] [Type B, embossed surface].
- C. Thickness: [0.080 inch (2.0 mm)] [0.100 inch (2.5 mm)] [0.120 inch (3.0 mm)] [0.125 inch (3.2 mm)] <Insert thickness>.
- D. Size: [12 by 12 inches (305 by 305 mm)] [18 by 18 inches (457 by 457 mm)] [24 by 24 inches (610 by 610 mm)] [36 by 36 inches (914 by 914 mm)] [3 by 36 inches (76 by 914 mm)] <Insert size>.
- E. Colors and Patterns: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from full range of industry colors].

2.2 RUBBER FLOOR TILE <Insert drawing designation>

- A. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
1. Burke Mercer Flooring Products, Division of Burke Industries Inc.; <Insert product name or designation>.
 2. Endura Rubber Flooring, a division of Burke Industries Inc.; <Insert product name or designation>.
 3. Estrie Products International, American Biltrite (Canada) Ltd.; <Insert product name or designation>.
 4. Flexco; <Insert product name or designation>.
 5. Johnsonite; <Insert product name or designation>.
 6. Mondo Rubber International, Inc.; <Insert product name or designation>.
 7. Nora Rubber Flooring, Freudenberg Building Systems, Inc.; <Insert product name or designation>.
 8. PRF USA Inc.; <Insert product name or designation>.
 9. R.C.A. Rubber Company (The); <Insert product name or designation>.
 10. Roppe Corporation, USA; <Insert product name or designation>.
 11. <Insert manufacturer's name; product name or designation>.
- B. Tile Standard: ASTM F 1344, [Class I-A, homogeneous rubber tile, solid color] [Class I-B, homogeneous rubber tile, through mottled] [Class II-A, laminated rubber tile, solid-color wear layer] [Class II-B, laminated rubber tile, mottled wear layer].
- C. Hardness: [Not less than 85 as required by ASTM F 1344, measured using Shore, Type A durometer per ASTM D 2240] [Manufacturer's standard hardness].
- D. Wearing Surface: [Smooth] [Textured] [Molded pattern].
1. Molded-Pattern Figure: [Raised discs] [Raised squares] <Insert pattern>.
- E. Thickness: [0.125 inch (3.2 mm)] <Insert thickness>.
- F. Size: [12 by 12 inches (305 by 305 mm)] [24 by 24 inches (610 by 610 mm)] <Insert size>.
- G. Colors and Patterns: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from full range of industry colors].

2.3 VINYL COMPOSITION FLOOR TILE <Insert drawing designation>

- A. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
1. AB ColorPlus, American Biltrite (Canada) Ltd.; <Insert product name or designation>.
 2. Armstrong World Industries, Inc.; <Insert product name or designation>.
 3. Congoleum Corporation; <Insert product name or designation>.
 4. Mannington Mills, Inc.; <Insert product name or designation>.

5. Tarkett, Inc.; **<Insert product name or designation>**.
 6. Vinylasa Tile, Distributed by American Tile Inc.; **<Insert product name or designation>**.
 7. **<Insert manufacturer's name; product name or designation>**.
- B. Tile Standard: ASTM F 1066, **[Class 1, solid-color tile] [Class 2, through-pattern tile] [Class 3, surface-pattern tile]**.
- C. Wearing Surface: **[Smooth] [Embossed]**.
- D. Thickness: **[0.125 inch (3.2 mm)] <Insert thickness>**.
- E. Size: **12 by 12 inches (305 by 305 mm)**.
- F. Colors and Patterns: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from full range of industry colors]**.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
 - b. Rubber Floor Adhesives: Not more than 60 g/L.
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

4. Moisture Testing: Perform tests recommended by floor covering manufacturer[**and as follows**]. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation 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)**] **<Insert emission>** in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum [**75%**] **<Insert acceptable percentage>** relative humidity level measurement.
- C. 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.
- D. Do not install floor tiles until they are same temperature as 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.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 1. Lay tiles [**square with room axis**] [**at a 45-degree angle with room axis**] [**in pattern indicated**] **<Insert requirements>**.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 1. Lay tiles [**with grain running in one direction**] [**with grain direction alternating in adjacent tiles (basket-weave pattern)**] [**in pattern of colors and sizes indicated**].
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

- G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply [**one**] [**two**] [**three**] **<Insert requirements>** coat(s).
- C. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 09 68 00 - CARPETING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparation of surfaces to receive carpeting.
2. Carpet:
 - a. Furnished by Owner, installed by Contractor
 - b. Stretch-in Installation
 - c. Direct-Glue-Down Installation
 - d. Double-Glue-Down Installation
 - e. Carpet with Attached-Cushion Installation
 - f. Carpet with Preapplied Adhesive Installation
 - g. Carpet Base
3. Carpet Cushion:
 - a. Furnished by Owner, installed by Contractor
4. Accessories, including tack strips, adhesives tapes and all other required accessories.
5. Transition edges
6. Carpet stair nosings

B. Related Documents:

1. Seam Layout Drawings
2. Sleep Inn Interior Design Documents.

1.2 REFERENCE STANDARDS

A. [ASTM International \(ASTM\)](#)

1. F710 "Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring"
2. F1869 "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride"

B. [Carpet & Rug Institute \(CRI\)](#)

1. CRI 104-2002, "Standard for Installation Specification of Commercial Carpet", Current Edition

C. [Federal Specifications \(FS\)](#)

1. FS DDD-C-0095 Carpet and rugs, wool, nylon, acrylic, modacrylic, polyester, polypropylene.

D. [Occupational Safety & Health Administration \(OSHA\)](#) Regulations:

1. [OSHA](#) Regulation 29 [CFR](#) Toxic and Hazardous Substances 1910-1200 Hazard Communication

E. [U.S. Department of Commerce \(DOC\)](#)

1. Federal Flammability standard [DOC](#) FF 1-70 (Methenamine Pill test [ASTM](#) D2859).

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Firm with not less than 5 years of experience in installation of commercial carpeting of type, quantity, and installation methods similar to work of this Section.
 1. Installer shall be certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Successful vendor shall be responsible for field measurements to determine carpet layout.
 1. The installation contractor is responsible for verification of quantities within [\[fourteen \(14\) days\]](#) on new construction. The contractor shall provide take-offs of all carpet and padding, as required for a complete installation. No compensation will be allowed to the installation contractor for materials and labor that may be required to install additional carpeting because of incorrect quantity takeoffs.
- C. All products shall comply with the Carpet and Rug Institute Indoor Air Quality Testing Program (Green Label).
- D. Carpet Surface Burning Characteristics: Provide carpet identical to that tested for the following fire performance characteristics, per test method indicated below, by [UL](#) or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify carpet with appropriate markings of applicable testing and inspecting organization.
 1. Test Method: [DOC](#) FF 1-70
 2. Rating: Pass
- E. The carpet contractor is responsible for reviewing carpet manufacturer's published installation instructions prior to installation. This includes understanding dye lots, pattern sequencing, pattern matching and any special instructions. Failure to abide by the manufacturer's instructions could result in a backcharge to contractor for corrections to the installation.
- F. Contractor is responsible for damages to work performed by others.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 1. A copy of the manufacturer's printed installation manual shall accompany Bid for review and approval by the Owner's Representative.
 2. Shop Drawings showing layout and seaming diagrams. Indicate pile or pattern direction and locations and types of edge strips. Indicate columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet. Show installation details at special conditions.
 3. Shop Drawings showing layout diagrams: Indicate the following:
 - a. Carpet type, color and dye lot.
 - b. Seam locations, types and methods.
 - c. Type of installation.
 - d. Pattern type, location, and direction.
 - e. Type, color, and dimensioned location of insets and borders.

- f. Type, color, and location of edge, transition, and other accessory strips.
 - g. Indicate columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
 - h. Transition details to other flooring materials.
4. Carpet Manufacturer's Written Certification that the carpet bid meets the requirements of this specification.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with the Carpet and Rug Institute's [CRI](#) 104, Section 05: "Storage and Handling."
- B. Do not deliver carpet until areas of building are ready for carpet installation. Provide protection from loss or damage.
- C. Store materials in original undamaged packages and containers, inside well-ventilated, dry area protected from weather, moisture, soilage, extreme temperatures and humidity. Lay flat, blocked off ground. Maintain minimum temperature of 68 degrees F. (20 degrees C.) at least three days prior to and during installation in area where materials are stored. Never stack carpet more than two rolls high or stand up on roll ends on job site. Do not bend or fold carpet in storing.
- D. Carpet shall never be stacked more than five (5) rolls high.

1.6 PROJECT CONDITIONS

- A. General: Comply with [CRI](#) 104, Section 07: "Site Conditions."
- B. Do not commence with carpet installation until painting and finishing work is complete and ceilings and overhead work has been tested, approved, and completed.
- C. In areas to receive carpet, room temperatures shall be maintained at 65-90 degrees F and with relative humidity ranging between 20 and 65 percent minimum for 72 hours prior to, during, and 72 hours following application. Materials shall be conditioned at application temperature and humidity at least 24 hours prior to application. Provide sufficient lighting for carpet installation.
- D. Contractor shall provide method approved by the Owner's representative to mechanically exhaust all spaces to receive carpet to the exterior during installation and a minimum of 72 continuous hours, or length of time required by the manufacturer or Owner after installation.

1.7 WARRANTY

- A. It is the carpet Contractors responsibility to fill out the adhesive manufacturer warranties. The warranty must be returned to the adhesive manufacturer and a copy sent to the Contractor's representative.

1.8 EXTRA MATERIALS

- 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. The Owner shall be permitted to view all carpet scraps and retain any that is chosen for future repairs before they are removed from the job site.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Carpet: All carpet and padding materials shall be provided as designated on the finish schedules.
- B. Carpet Cushion
 - 1. Carpet Cushion:
 - a. All material shall comply with HUD UM 72a.

2.2 ACCESSORIES

- A. Seaming: Hot-melt seaming adhesive or similar product recommended by carpet manufacturer for taping seams and buttering cut edges at backing to form secure seams and prevent pile loss at seams.
- B. Adhesive: As recommended by carpet manufacturer for use intended, complying with the following: Adhesive shall be antimicrobial with no hazardous vapors and contain no carcinogenic materials, per [OSHA](#) Regulation 29 CFR 1910-1200. All containers shall contain material safety data sheets (MSDS) and be available at job site for inspection.
- C. Tack Strips:
 - 1. Water-resistant plywood strips as required to match pad thickness and in compliance with [CRI](#) 104, Section 11.3.
 - 2. Commercial with 3 rows of pins.
 - a. Type 1: Prenailed (Concrete) for anchoring into concrete sub-floor.
 - b. Type 2: Extra long nails for cementitious leveling bed over plywood sub-floor.
- D. Concrete Leveling and Patching compounds:
 - 1. For areas up to 4 square feet:
 - a. Feather finish, use to smooth ridges, fill cracks, gouges and joints.
 - b. Trowelable underlayment patch for thickness up to ½ inch without aggregate; up to 1 inch with aggregate. Can be feather edged.
 - 2. For areas exceeding 4 square feet:
 - a. Self-leveling, pourable or pumpable underlayment for thicknesses up to 5 inches. Can be feather edged.
- E. Transition Edges
 - 1. Carpet Transition Edges: Refer to Section 09 65 13.33.
- F. Miscellaneous Materials: Including edge strips not specifically described, as recommended by manufacturers of carpet, and other carpeting products; and selected by Installer to meet project circumstance and requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.
- B. Concrete Subfloors: General Contractor shall verify that concrete slabs comply with [ASTM](#) F710 and the following:
 - 1. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpeting.
 - 2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits. Sand smooth or fill voids to obtain a smooth level substrate, any noticeable deviation in flooring may be rejected.
 - 3. Ensure floors are level with maximum surface variation of 1/4" in 10'.
 - 4. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpeting and carpet cushion manufacturers, including [ASTM](#) F1869.
 - a. It is essential that moisture tests be taken on all concrete floors regardless of age and grade level. The test should be in accordance with [ASTM](#) F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride. One test should be conducted for every 1000 sq. ft. of flooring and the results not exceed 3 lbs. Per 1000 sq. ft. in 24 hours. If the test results exceed the limitations, the installation must not proceed until the problem has been corrected.
 - 5. Subfloor Alkalinity Conditions: Before installing carpet Contractor shall verify that a pH range of 5 to 9 when subfloor is wetted with potable water and pHydration paper is applied.
- C. Report conditions contrary to Contract requirements which would prevent a satisfactory installation.
 - 1. Do not proceed with installation until unsatisfactory conditions have been corrected.
 - 2. Failure to call attention to any defects or imperfections will be construed as acceptance and approval of the subfloor.

3.2 SITE ENVIRONMENTAL PROCEDURES

- A. Indoor Air Quality:
 - 1. Temporary ventilation:
 - a. Ventilate products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant sources and residues. Provide a temperature range of 60 degrees F minimum to 90 degrees F maximum for minimum 72 hours. Do not ventilate within limits of Work unless otherwise approved by Architect.
 - 2. Immediately after installation, clean carpet thoroughly with a high-efficiency particulate air (HEPA) filtration vacuum.

3.3 PREPARATION

- A. General: Comply with [CRI](#) 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet manufacturer's written instructions for preparing substrates indicated to receive carpet installation.
- B. Use proper leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
 - 1. Level subfloor within 1/4" in 10', noncumulative, in all directions. Sand or grind protrusions, bumps, and ridges. Patch and repair cracks and rough areas. Fill depressions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by the following:
 - 1. Carpet manufacturer
 - 2. Carpet cushion manufacturer

3.4 INSTALLATION- GENERAL

- A. Direct-Glue-Down Installation: Comply with [CRI](#) 104, Section 8, "Direct Glue-Down Installation"
 - 1. In the case of direct glue-down, carpet glued to floor, no padding required, follow the manufacturers specifications.
- B. Double-Glue-Down Installation: Comply with [CRI](#) 104, Section 9, "Double Glue-Down Installation"
- C. Carpet with Attached-Cushion Installation: Comply with [CRI](#) 104, Section 10, "Attached Cushion"
- D. Carpet with Preapplied Adhesive Installation: Comply with [CRI](#) 104, Section 10.4, "Pre-Applied Adhesive Systems"
- E. Stretch-In Installation: Comply with [CRI](#) 104, Section 11, "Stretch-In Installation"
 - 1. Install tack strip with adhesive, drill and pin, or nailing, or combination, where required for adequate strength.
 - 2. Locate Tack strip 1/4 inch from wall to conceal carpet edge between stripping and base of wall. Strip entire perimeter of each carpeted space and at obstructions and cutouts.
 - 3. Tap down tackstrip pins in Guestrooms at Entrances, Bathroom, Closets, and Balconies.
 - 4. Power stretch carpet uniformly in both directions the exact amount recommended by carpet manufacturer; trim edges, secure to stripping and conceal behind edge of stripping.
 - a. Stretch-in installations must be power stretched uniformly length and width 1% to 1.5% using a power stretcher.
 - 5. Use a carpet covered minimum 48 inch long 4 x 4 buffer block between power stretcher and wall to prevent damage to wall. Use a wall trimmer to trim carpet along walls and abutments. This Contractor shall be responsible for wall damage caused by installation Work.
 - a. Trimmer must be adjusted to leave sufficient excess carpet to tuck into gullies.

- F. Stair Installation: Comply with [CRI](#) 104, Section 13, "Carpet on Stairs" for stretch-in installation.
- G. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
 - 1. Level adjoining border edges
- H. Do not bridge building expansion joints with carpet.
- I. Cut and fit carpets to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
 - 1. Check matching of carpet before cutting and ensure there is no visible variation between cut pieces.
 - 2. Cut carpet, where required, in a manner to allow proper seam and pattern match. Ensure cuts are straight and true and unfrayed.
- J. Carpet shall extend to the back of all toe spaces, under all millwork, cabinetwork, convectors, bookshelving, and similar items to the limiting planes of the floor surface. Where carpet terminates at a doorway, termination of carpet shall occur under the edge of the closed door, or at the side of the threshold where this is required. Cut and fit carpeting to all obstructions protruding from the floor surface, such as columns, pipes, thresholds, electrical, and telephone outlets, etc. All raw edges shall be sealed and securely and neatly tucked into place.
- K. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- L. Install pattern parallel to walls and borders.
- M. Carpet shall be installed by experienced carpet layers in an approved manner, using adhesive and procedures, as approved by carpet manufacturer. Install carpet with pile running in the same direction, unless specifically directed to do otherwise.
- N. Install carpet cushion seams at 90-degree angle with carpet seams.
- O. The final carpet pattern, layout, edge binding locations shall be as directed and approved by Owner's Representative. All associated installation shall be by this Contractor.

3.5 INSTALLATION - BROADLOOM CARPET

- A. Lay out entire roll of each roll of carpet full for Owners Representative's approval.
- B. Check matching of carpet before cutting and ensure there is no visible variation between dye lots. Should variations occur, notify Architect through the Construction Manager for review.
- C. Cut carpet, where required, in a manner to allow proper seam and pattern match. Ensure cuts are straight and true and unfrayed.
- D. Where possible and practical, locate seams in areas of least amount of traffic. Cross seams required due to length of rolls received shall be placed to avoid occurrence at conspicuous locations, near doors or at pivot points. No seams shall occur at doorways and entries perpendicular to the doors or entries. Seams occurring at doors parallel to doors shall be centered directly under the door. Seams occurring at corridor change of direction shall follow the wall line parallel to the carpet direction.

- E. Join seams in recommended manner and so as not to detract from the appearance of the carpet installation and decrease its life expectancy. Ensure seams are straight, not overlapped or peaked, and free of gaps.
- F. Lay carpet on floors with run of the pile in consistently same direction.
- G. Do not change run of pile or grain in any one room or from one room to next.
- H. Cut and fit carpet neatly around projections though floor and to walls and other vertical surfaces. Fit carpet snugly to walls or other vertical surface where no base is scheduled, leaving no gaps.
- I. Do not place heavy objects, such as furniture, on carpeted surfaces for minimum of 24 hours.
- J. Entire carpet installation is to be laid tight and flat to subfloor, well-fastened at edges, and present a uniform, pleasing appearance. Ensure monolithic color, pattern, and texture match within any one area.
- K. Install edging strips where carpet terminated at finish flooring. Use full-length pieces only. Butt tight to vertical surfaces. Where splicing cannot be avoided, butt ends tight and flush.
- L. Where carpet is glued down, vacuum clean substrate. Spread adhesive in quantity recommended by manufacture to ensure proper adhesion over full area of installation. Apply only enough adhesive to permit proper adhesion of carpet before initial set.

3.6 SEALING CUT EDGES

- A. To prevent fraying and raveling at all seams and transition areas, a continuous bead of seam adhesive must be applied to the first edge where the face yarn enters the backing.
- B. On woven carpet, all cut edges at seams and transition areas must be secured with a latex seam adhesive immediately following the seam trimming.

3.7 SEAMING

- A. Install pad and carpet seams in accordance with manufacturer's published instructions.
- B. Locate pad seams at right angles to carpet seams. Where not possible to locate at right angles, locate pad seam minimum 6 inches away from carpet seams. Butt pad edges tightly together to form seams without gaps. Tape pad seams.
- C. Maintain uniformity of carpet direction and lay of pile. At doors, center seams under doors; do not place seams in traffic direction at doorways.
- D. The seaming iron with heat shield must be of proper size, matching the hot melt tape being used.
- E. The proper head setting and exposure time must be used to assure proper transfer without creating damage to backing or pile yarn.
- F. Where conflicts between Owner's requirements and manufacturer's requirements occur, use Owner's requirements.

3.8 ACCESSORIES

- A. Provide carpet edge guard where edge of carpet is exposed; anchor guards to substrate. Edge guard shall be used in all doorways or openings where no sill is installed or as required.
- B. Stair Nosing: Coordinate with installation of carpet so that edge of the carpet is installed under edge of nosing or otherwise protected from unraveling.

3.9 ADJUSTING

- A. Stretch-In Installation: Restretch carpet sixty days after Substantial Completion, as directed by Owner.

3.10 PROTECTION

- A. Comply with [CRI](#) 104, Section 15, "Protection of Indoor Installation".
- B. Remove and dispose of debris and unusable scraps daily.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure carpet is without damage or deterioration at the time of Substantial Completion.
- D. The General Trades Contractor and the Carpet Installation Contractor shall be responsible for the protection of all carpet until a final inspection is made and installation has been accepted.
 - 1. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.
- E. Maintenance Materials: Deliver specified overrun (if any) and usable scraps of carpet to Owner's designated storage space, properly packaged (paper wrapped) and identified. Usable scraps are defined to include roll ends of less than 9'-0" length, and 3'-0" wide. Dispose of smaller pieces as "construction waste".

3.11 CLEANING

- A. Vacuum carpet daily using commercial machine with face-beater element. Remove spots and replace carpet where spots cannot be removed. Remove any protruding face yarn using sharp scissors. Knock down tacks at entries to baths and guest rooms (to protect feet).

END OF SECTION 09 68 00 (09680)

SECTION 09 72 00 - WALL COVERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes Owner furnished / Contractor installed wall coverings.
- B. Related Sections include the following:
 - 1. Division 9 Section "Painting" for primers, coatings, and paint.

1.3 SUBMITTALS

- A. Product Data: For each type of installation product used.
- B. Schedule: For wall coverings. Use same designations indicated on Drawings.
- C. Maintenance Data: For wall coverings to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide wall covering adhesives with the following fire-test-response characteristics as determined by testing identical products applied with identical adhesives to substrates per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
- B. Mockups: Build mockups to demonstrate appearance and aesthetic effects and set quality standards for installation.
 - 1. Provide mockup of one room. Architect shall designate the room.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install wall coverings 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.
- B. Lighting: Do not install wall covering until a lighting level of not less than 15 fc is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Wall-Covering Materials: For each type, full-size units equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 WALL COVERINGS

- A. TBD

2.2 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application, as recommended in writing by wall-covering manufacturer.
- B. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Division 9 Section "Painting" and recommended in writing by wall-covering manufacturer for intended substrate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair wall covering's bond, including mold, mildew, oil, grease, incompatible primers, dirt, and dust.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity.
 - 3. Gypsum Board: Prime with primer recommended by wall-covering manufacturer.
 - 4. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.
- E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION

- A. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
- D. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
- E. Match pattern 72 inches above the finish floor.
- F. Install seams vertical and plumb at least 6 inches from outside corners and 3 inches from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.
- G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- H. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.

3.4 CLEANING

- A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 097200

SECTION 09 91 13 - EXTERIOR PAINTING

1.1 QUALITY ASSURANCE

- A. Mockups for each color and finish.

1.2 PAINT, GENERAL

- A. Products MPI listed.

1.3 SOURCE QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

1.4 EXTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:

- 1. Latex system.
- 2. Latex aggregate/latex system.
- 3. High-build latex system.
- 4. Latex aggregate system.

- B. Concrete Substrates, Traffic Surfaces:

- 1. Latex floor paint system.
- 2. Alkyd floor enamel system.
- 3. Water-based clear sealer system.
- 4. Solvent-based clear sealer system.

- C. Clay-Masonry Substrates:

- 1. Latex system.
- 2. High-build latex system.
- 3. Latex aggregate system.

- D. CMU Substrates:

- 1. Latex system.
- 2. Latex over alkali-resistant primer system.
- 3. High-build latex system.
- 4. Latex aggregate system.

- E. Steel Substrates:

- 1. Water-based light industrial coating system.
- 2. Alkyd system.

3. Quick-drying enamel system.
 4. Aluminum paint system.
- F. Galvanized-Metal Substrates:
1. Latex system.
 2. Water-based light industrial coating system.
 3. Alkyd system.
- G. Aluminum Substrates:
1. Latex system.
 2. Water-based light industrial coating system.
 3. Alkyd system.
- H. Stainless-Steel Substrates:
1. Latex system.
 2. Water-based light industrial coating system.
- I. Wood Substrates: Including **[wood trim] [architectural woodwork] [doors] [windows] [wood siding] [wood fences] [wood-based panel products] [glued-laminated construction] [exposed joists] [exposed beams] [wood shingles and shakes (excluding roofs)] <Insert description>**.
1. Latex system.
 2. Latex over alkyd primer system.
 3. Alkyd system.
- J. Wood Substrates, Traffic Surfaces: Including **[lumber decking] [stairs] <Insert description>**.
1. Latex system.
 2. Latex over alkyd primer system.
 3. Alkyd floor enamel system.
- K. Plastic Trim Fabrication Substrates:
1. Latex system.
 2. Alkyd system.
- L. Portland Cement Plaster Substrates:
1. Latex system.
 2. Latex over alkali-resistant primer system.
 3. High-build latex system.
- M. Exterior Gypsum Board Substrates:
1. Latex system.

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END OF SECTION 099113

SECTION 09 91 23 - INTERIOR PAINTING

1.1 QUALITY ASSURANCE

- A. Mockups for each color and finish.

1.2 PAINT, GENERAL

- A. Products MPI listed.
- B. VOC Content: Complying with [LEED-NC] [LEED-CS] Credit EQ 4.2.
- C. VOC Content and Chemical Components: Complying with LEED-CI Credit EQ 4.2.
- D. Low-Emitting Materials: Complying with LEED for Schools Credit EQ 4.

1.3 SOURCE QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

1.4 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
 - 1. Latex system.
 - 2. Latex over latex aggregate system.
 - 3. Institutional low-odor/VOC latex system.
 - 4. High-performance architectural latex system.
 - 5. Water based light industrial coating system.
 - 6. Alkyd system.
- B. Concrete Substrates, Traffic Surfaces:
 - 1. Latex floor enamel system.
 - 2. Alkyd floor enamel system.
 - 3. Concrete stain system.
 - 4. Water-based clear sealer system.
 - 5. Solvent-based clear sealer system.
- C. Clay-Masonry Substrates:
 - 1. Latex system.
 - 2. Latex aggregate system.
 - 3. Institutional low-odor/VOC latex system.
 - 4. High-performance architectural latex system.
 - 5. Water-based light industrial coating system.

6. Alkyd system.
- D. CMU Substrates:
1. Latex system.
 2. Institutional low-odor/VOC latex system.
 3. High-performance architectural latex system.
 4. Water-based light industrial coating system.
 5. Alkyd system.
- E. Steel Substrates:
1. Latex over alkyd primer system.
 2. Water-based dry-fall system.
 3. Institutional low-odor/VOC latex system.
 4. High-performance architectural latex system.
 5. Water-based light industrial coating system.
 6. Alkyd system.
 7. Quick-drying enamel system.
 8. Alkyd dry-fall system.
 9. Aluminum paint system.
- F. Galvanized-Metal Substrates:
1. Latex over waterborne primer system.
 2. Water-based dry-fall system.
 3. Institutional low-odor/VOC latex system.
 4. High-performance architectural latex system.
 5. Water-based light industrial coating over waterborne primer system.
 6. Aluminum paint system.
- G. Aluminum Substrates:
1. Latex system.
 2. Institutional low-odor/VOC latex system.
 3. High-performance architectural latex system.
 4. Water-based light industrial coating system.
 5. Alkyd system.
 6. Aluminum paint system.
- H. Wood Substrates: Including **[wood trim] [architectural woodwork] [doors] [windows] [wood-based panel products] [glued-laminated construction] [exposed joists] [exposed beams] <Insert description>**.
1. Latex system.
 2. Latex over alkyd primer system.
 3. Institutional low-odor/VOC latex system.
 4. High-performance architectural latex system.
 5. Alkyd system.

I. Wood Substrates, Traffic Surfaces:

1. Latex floor paint system.
2. Alkyd floor enamel system.

J. Fiberglass and Plastic Substrates:

1. Latex system.
2. Institutional low-odor/VOC latex system.
3. High-performance architectural latex system.
4. Water-based light industrial coating system.
5. Alkyd system.

K. **[Gypsum Board] [Plaster]** Substrates:

1. Latex system.
2. Institutional low-odor/VOC latex system.
3. High-performance architectural latex system.
4. Water-based light industrial coating system.
5. Alkyd over latex primer system.

L. Spray-Textured Ceiling Substrates:

1. Latex (flat) system.
2. Latex system.
3. Latex over alkyd primer system.
4. Alkyd (flat) system.
5. Alkyd system.

M. **[Cotton or Canvas] [and] [ASJ]** Insulation-Covering Substrates: Including **[pipe and duct coverings]** <Insert description>.

1. Latex system.
2. Institutional low-odor/VOC latex system.
3. Alkyd over latex primer system.
4. Aluminum paint system.

END OF SECTION 099123

SECTION 10 14 00 - SIGNAGE

PART 1 GENERAL

SUMMARY

This Section includes the following:

- Plaques.
- Dimensional characters.
- Panel signs.

DEFINITIONS

ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

SUBMITTALS

Product Data: For each type of product indicated.

Shop Drawings: Show fabrication and installation details for signs.

Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign. Retain subparagraph below if equipment includes wiring.

Wiring Diagrams: Power, signal, and control wiring.

Samples: For each sign type and for each color and texture required.

QUALITY ASSURANCE

Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 PRODUCTS

MATERIALS

Aluminum Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.

Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.

Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 6063-T5.

Brass Castings: ASTM B 584, Alloy UNS No. C85200 (high-copper yellow brass).

Brass, Yellow, Sheet: ASTM B 36/B 36M, Alloy UNS No. C26000.

Bronze Castings: ASTM B 584, Alloy UNS No. C86500 (No. 1 manganese bronze).

Bronze Plate: ASTM B 36/B 36M.

Copper Sheet: ASTM B 152/B 152M.

Steel:

Steel Sheet: [electrolytic zinc-coated, ASTM A 591/A 591M, with steel sheet substrate complying with ASTM A 1008/A 1008M, commercial steel, exposed].

Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type [304] [316], stretcher-leveled standard of flatness.

Steel Members Fabricated from Plate or Bar Stock: ASTM A 529/A 529M or ASTM A 572/A 572M, **42,000-psi (290-MPa)** minimum yield strength.

For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness.

Fiberglass Sheet: Molded, seamless, thermosetting, glass-fiber-reinforced polyester panels with a minimum tensile strength of **15,000 psi (103 MPa)** when tested according to ASTM D 638 and with a minimum flexural strength of **30,000 psi (207 MPa)** when tested according to ASTM D 790.

Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).

Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating:

Impact Resistance: **16 ft-lbf/in. (854 J/m)** per ASTM D 256, Method A.

Tensile Strength: **9000 lbf/sq. in. (62 MPa)** per ASTM D 638.

Flexural Modulus of Elasticity: **340,000 lbf/sq. in. (2345 MPa)** per ASTM D 790.

Heat Deflection: **265 deg F (129 deg C)** at **264 lbf/sq. in. (1.82 MPa)** per ASTM D 648.

Abrasion Resistance: 1.5 percent maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D 1044.

Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of **3 mils (0.076 mm)** with pressure-sensitive adhesive backing, suitable for exterior applications.

PLAQUES

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:

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

Basis-of-Design Product: Subject to compliance with requirements, or a comparable product by one of the following:

Advance Corporation; Braille-Tac Division.
A. R. K. Ramos.
Gemini Incorporated.
Matthews International Corporation; Bronze Division.
Metal Arts; Div. of L&H Mfg. Co.
Mills Manufacturing Company.
Nelson-Harkins Industries.
Southwell Company (The).

Cast Plaques: Provide castings free of pits, scale, sand holes, and other defects, as follows:

Plaque Material: Aluminum, Bronze.
Background Texture: Manufacturer's standard texture.
Border Style:
Mounting:

Etched Plaques: Provide metal sheet or plate for etching, as follows:

Plaque Material: Aluminum, Brass, Bronze.
Color(s): As selected by Architect from manufacturer's full range.
Edge Style:
Mounting:
Thickness:

DIMENSIONAL CHARACTERS

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:

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

Basis-of-Design Product: Subject to compliance with requirements or a comparable product by one of the following:

ACE Sign Systems, Inc.
Advance Corporation; Braille-Tac Division.
A. R. K. Ramos.
ASI-Modulex, Inc.
Bunting Graphics, Inc.
Charleston Industries, Inc.

Gemini Incorporated.
Grimco, Inc.
Interface Sign Systems, Inc.
Metal Arts; Div. of L&H Mfg. Co.
Mills Manufacturing Company.
Mohawk Sign Systems.
Nelson-Harkins Industries.
Signature Signs, Incorporated.
Southwell Company (The).

Cast Characters: Produce characters with smooth flat faces, sharp corners, and precisely formed lines and profiles, free of pits, scale, sand holes, and other defects. Cast lugs into back of characters and tap to receive threaded mounting studs. Alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated. Comply with the following requirements.

Character Material: [Brushed Aluminum].
Thickness: [As indicated].
Color(s): [As selected by Architect from manufacturer's full range].
Mounting: [Rosettes and fasteners matching character finish] for substrates encountered.

Aluminum Extrusions: Comply with the following requirements:

Finish: [Anodized].
Thickness: [As indicated].
Color(s): [As selected by Architect from manufacturer's full range].
Mounting: Concealed studs [noncorroding] for substrates encountered.

Fabricated Channel Characters: Form exposed faces and sides of characters to produce surfaces free from warp and distortion. Include internal bracing for stability and attachment of mounting accessories. Comply with the following requirements:

Illuminated [Backlighted] Channel Characters: Manufacturer's standard [LED] lighting including transformers, insulators, and other components. Make provisions for servicing and concealing connections to building electrical system.

Aluminum Sheet: Not less than 0.090 inch (2.29 mm) thick.

Finish: [Anodized].
Color: [As selected by Architect from manufacturer's full range].

Bronze Sheet: Not less than 0.032 inch (0.81 mm) thick.

Brass Sheet: Not less than 0.032 inch (0.81 mm) thick.

Copper Sheet: Not less than 0.032 inch (0.81 mm) [0.048 inch (1.22 mm)] thick.

Steel Sheet: Painted, not less than 0.050 inch (1.27 mm) thick for face and 0.031 inch (0.78 mm) thick for returns.

Color: [As selected by Architect from manufacturer's full range].

Stainless-Steel Sheet: Not less than 0.050 inch (1.27 mm) thick for face and 0.031 inch (0.78 mm) thick for returns.

Finish: [No. 4] [No. 8] <Insert description>.

Provide manufacturer's hardware for projection mounting of [backlighted] channel characters at standard distance from wall surface.

Provide translucent acrylic face sheet of thickness indicated. Attach characters to sheet metal back channels. Provide required to illuminate sign faces evenly.

Color: [As selected by Architect from manufacturer's full range].

Provide open-front, sheet metal channel characters.

Molded Plastic Characters: [Thermoformed] and as follows:

Illuminated Characters: Manufacturer's standard [LED] lighting including transformers, insulators, and other components. Make provisions for servicing and concealing connections to building electrical system.

[Integral Color] : [As selected by Architect from manufacturer's full range].

Cutout Characters: Provide characters with square-cut, smooth [eased] edges. Comply with the following requirements:

Acrylic: [0.25 inch (6.35 mm)] thick.

Metal face laminated to acrylic base [with painted edges].

Brass Face: [Satin] finish.

Stainless-Steel Face: [No. 4] [No. 8] finish.

Color: [As selected by Architect from manufacturer's full range].

Aluminum Sheet: [0.125 inch (3.18 mm)] thick.

Finish: [Anodized].

Color: [As selected by Architect from manufacturer's full range].

Brass Sheet, Yellow: [0.125 inch (3.18 mm)] thick.

Bronze Sheet: [0.125 inch] thick.

Vinyl: Pressure sensitive, [3.5 mils (0.09 mm)] thick.

Color: [As selected by Architect from manufacturer's full range].

Mounting: [Adhesive] [with concealed noncorroding studs] for substrates encountered.

PANEL SIGNS

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:

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

Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

ACE Sign Systems, Inc.
Advance Corporation; Braille-Tac Division.
Allen Industries Architectural Signage
Allenite Signs; Allen Marking Products, Inc.
APCO Graphics, Inc.
ASI-Modulex, Inc.
Best Sign Systems Inc.
Bunting Graphics, Inc.
Fossil Industries, Inc.
Gemini Incorporated.
Grimco, Inc.
Innerface Sign Systems, Inc.
InPro Corporation
Matthews International Corporation; Bronze Division.
Mills Manufacturing Company.
Mohawk Sign Systems.
Nelson-Harkins Industries.
Seton Identification Products.
Signature Signs, Incorporated.
Supersine Company (The)

Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus **1/16 inch (1.5 mm)** measured diagonally from corner to corner, complying with the following requirements:

Aluminum Sheet: **[0.080 inch (2.03 mm)]** thick.
Laminated, Aluminum Faced Sheet: **[0.020-inch- (0.51-mm-)]** thick aluminum sheet laminated to each side of **[0.197-inch- (5.0-mm-)]** thick, [acrylic] backing[with painted edges].
Laminated, Polycarbonate Faced Sheet: **[0.060-inch- (1.52-mm-)]** thick, polycarbonate face sheet laminated to each side of **[0.197-inch- (5.0-mm)]** thick phenolic backing.
Acrylic Sheet: **[0.080 inch (2.03 mm)]** thick.
PVC Sheet: **[0.080-inch- (2.03-mm-)]** thick, extruded, high-impact PVC plastic [in color to match face color].
High-Pressure Decorative Laminate: **0.048 inch (1.21 mm)** thick.
Phenolic-Backed Photopolymer Sheet: Provide light-sensitive, water-wash photopolymer face layer bonded to a phenolic base layer to produce a composite sheet with overall, face layer, and base-layer thicknesses, respectively, of **[0.120, 0.040, and 0.080 inch (3.0, 1.0, and 2.03 mm)]**.
Laminated Sheet: High-pressure engraved stock with[contrasting color] face laminated to acrylic core [as selected by Architect from manufacturer's full range].
Laminated, Etched Photopolymer: Raised graphics[with Braille] **1/32 inch (0.8 mm)** above surface with contrasting colors [as selected by Architect from manufacturer's full range] and laminated to acrylic back.
Laminated, Sandblasted Polymer: Raised graphics[with Braille] **1/32 inch (0.8 mm)** above surface with contrasting colors [as selected by Architect from manufacturer's full range] and laminated to acrylic back.
Edge Condition: [Beveled].

Corner Condition: [Rounded to radius indicated].
Mounting: [Unframed].

[Wall] mounted with [two-face tape].
Manufacturer's standard anchors for substrates encountered.

Color: [As selected by Architect from manufacturer's full range].
Tactile Characters: Characters and Grade 2 Braille raised **1/32 inch (0.8 mm)** above surface with contrasting colors.

Exterior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus **1/16 inch (1.5 mm)** measured diagonally from corner to corner, complying with the following requirements:

Aluminum Sheet: [**0.080 inch (2.03 mm)**] thick.
Laminated, Aluminum Faced Sheet: [**0.020-inch- (0.51-mm-)**] thick aluminum sheet laminated to each side of [**0.197-inch- (5.0-mm-)**] thick, [acrylic] backing[with painted edges].
Acrylic Sheet: [**0.060 inch (1.52 mm)**] [**0.080 inch (2.03 mm)**] <Insert dimension> thick.
Fiberglass Sheet: [**0.090-inch- (2.29-mm-)**] [**0.125-inch- (3.18-mm-)**] <Insert dimension> thick sheet.
Edge Condition: [Square cut] [Beveled] [Bullnose].
Corner Condition: [Square] [Rounded to radius indicated].
Mounting: [Framed] [Unframed] [As indicated].

[Wall] [Soffit] [Projection] mounted.
Manufacturer's standard[noncorroding] anchors for substrates encountered.

Color: [As indicated] [As selected by Architect from manufacturer's full range] <Insert color>.

Laminated [Interior] [Exterior] Signs: Solid phenolic panel core with graphic image covered with thermosetting resin face layer.

Surface Finish: [Mat] [Beaded] [Gloss] [UV resistant, outdoor].
Edge Condition: [Square cut] [Beveled] [Bullnose].
Corner Condition: [Square] [Rounded to radius indicated].
Thickness: [**1/8 inch (3 mm)**] [**1/4 inch (6 mm)**] <Insert dimension>.

Brackets: Fabricate brackets and fittings for bracket-mounted signs from extruded aluminum to suit panel sign construction and mounting conditions indicated. Factory paint brackets in color matching background color of panel sign .

Panel Sign Frames:

PVC Frames: Extruded, high-impact PVC plastic.

Color: [As indicated] [As selected by Architect from manufacturer's full range] [Match face color] <Insert color>.
Depth: [As indicated] <Insert dimension>.
Profile: [Square] [Beveled] [Rounded].
Corner Condition: [Square] [Rounded to radius indicated].
Mounting: As indicated.

[Wall] [Ceiling] [Projection] mounted with [concealed anchors] [magnetic tape]
[two-face tape].
Manufacturer's standard [noncorroding] anchors for substrates encountered.

Extruded-Aluminum Frames: Mitered [with concealed anchors] [and welded].

Color: [As indicated] [As selected by Architect from manufacturer's full range] <Insert color>.
Depth: [As indicated] <Insert dimension>.
Profile: [Square] [Beveled] [Rounded].
Corner Condition: [Square] [Rounded to radius indicated].
Mounting: As indicated.

[Wall] [Ceiling] [Projection] mounted with [concealed anchors] [magnetic tape]
[two-face tape].
Manufacturer's standard [noncorroding] anchors for substrates encountered.

Metal Frames:

Bronze Plate: Not less than 0.032 inch (0.81 mm) thick.
Brass Plate: Not less than 0.032 inch (0.81 mm) thick.
Steel Sheet: Painted, not less than 0.050 inch (1.27 mm) thick for face and 0.031 inch (0.78 mm) thick for returns.

Color: [As indicated] [As selected by Architect from manufacturer's full range]
<Insert color>.

Stainless-Steel Sheet: Not less than 0.050 inch (1.27 mm) thick for face and 0.031 inch (0.78 mm) thick for returns.
Depth: [As indicated] <Insert dimension>.
Corner Condition: [Square] [Rounded to radius indicated].
Mounting: As indicated.

[Wall] [Ceiling] [Projection] mounted with [concealed anchors] [magnetic tape]
[two-face tape].
Manufacturer's standard [noncorroding] anchors for substrates encountered.

Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of
[slide-in inserts] [transparent covers with paper inserts printed by Owner] [changeable panel
inserts for use in fixed frames] <Insert description>.

Furnish insert material and software for creating text and symbols for [PC-Windows]
[Macintosh] computers for Owner production of paper inserts.
Furnish insert material cut-to-size for changeable message insert.

Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying
with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be
accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges
free from burrs and cut marks; Braille dots with domed or rounded shape.

Panel Material: [Opaque acrylic sheet] [Photopolymer] [Clear acrylic sheet with opaque color coating, subsurface applied].

Raised-Copy Thickness: Not less than **1/32 inch (0.8 mm)**.

Engraved Copy: Machine engrave letters, numbers, symbols, and other graphic devices into panel sign on face indicated to produce precisely formed copy, incised to uniform depth.

Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.

Engraved Metal: Fill engraved copy with enamel.

Engraved Opaque Acrylic Sheet: Fill engraved copy with enamel.

Face-Engraved Clear Acrylic Sheet: Fill engraved copy with enamel. Apply opaque background color coating to back face of acrylic sheet.

Subsurface Copy: Apply minimum **4-mil- (0.10-mm-)** thick vinyl copy to back face of clear acrylic sheet forming panel face to produce precisely formed opaque image. Image shall be free of rough edges.

Subsurface Engraved Acrylic Sheet: Reverse-engrave back face of clear acrylic sheet. Fill resulting copy with enamel. Apply opaque background color coating over enamel-filled copy.

Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of **3 mils (0.076 mm)** with pressure-sensitive adhesive backing. Apply copy to [exposed face of panel sign] [glass] [doors] [wall surfaces] <Insert substrate>.

Panel Material: [Opaque acrylic sheet] [Clear acrylic sheet with opaque color coating, subsurface applied].

Colored Coatings for Acrylic Sheet: For copy [and] [background] [and frame] colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are UV and water resistant for [three] [five] years for application intended.

Color: [As indicated] [As selected by Architect from manufacturer's full range] <Insert color>.

ACCESSORIES

Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

FABRICATION

General: Provide manufacturer's standard signs of configurations indicated.

Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of

exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

ALUMINUM FINISHES

Clear Anodic Finish: Manufacturer's standard Class 1 clear anodic coating, 0.018 mm or thicker, over a [satin (directionally textured)] [polished (buffed)] [nonspecular as fabricated] mechanical finish, complying with AAMA 611.

Color Anodic Finish: Manufacturer's standard Class 1 integrally colored or electrolytically deposited color anodic coating, 0.018 mm or thicker, in [light bronze] [medium bronze] [dark bronze] [gold] [black] applied over a [satin (directionally textured)] [polished (buffed)] [nonspecular as fabricated] mechanical finish, complying with AAMA 611.

Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm), medium gloss.

STEEL FINISHES

Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

Factory Priming for Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment.

Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer, selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

STAINLESS-STEEL FINISHES

Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

Directional Satin Finish: No. 4 finish.

Mirrorlike Reflective, Nondirectional Polish: No. 8 finish.

When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

COPPER-ALLOY FINISHES

Sheet or Plate Finish: [Medium satin (directionally textured)] [Smooth specular (mirrorlike), buffed] finish.

Raised Finish: [Satin] [Polished] [Painted] <Insert description>.

Recessed Finish: Etched[, painted] <Insert description>.

Cast-[Bronze] [Brass] Character Finishes: Manufacturer's [standard satin finish] <Insert description> with exposed surfaces free from porosity, burrs, and rough spots; with returns finished with fine-grain air blast.

Cast-Bronze Plaque Finishes: Exposed surfaces free of porosity, burrs, and rough spots; with returns finished with fine-grain air blast.

Raised Areas: Hand-tool and buff borders and raised copy to produce manufacturer's standard [satin] [polished] finish.

Background Finish: [Painted] [Dark oxidized] [Green patina] <Insert description>.

Clear Protective Coating: Coat exposed surfaces of copper alloys with manufacturer's standard, clear organic coating specially designed for coating copper-alloy products.

ACRYLIC SHEET FINISHES

Colored Coatings for Acrylic Sheet: For copy [and] [background] [and frame] colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for [three] [five] years for application intended.

PART 3 EXECUTION

INSTALLATION

Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.

Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.

Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within **3 inches (75 mm)** of sign without encountering protruding objects or standing within swing of door.

Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.

Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.

Hook-and-Loop Tapes: Mount signs to smooth, nonporous surfaces.

Magnetic Tape: Mount signs to smooth, nonporous surfaces.

Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.

Shim Plate Mounting: Provide **1/8-inch- (3-mm-)** thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.

Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.

Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.

Bracket-Mounted Signs: Provide manufacturer's standard brackets, fittings, and hardware for mounting signs that project at right angles from walls and ceilings. Attach brackets and fittings securely to walls and ceilings with concealed fasteners and anchoring devices to comply with manufacturer's written instructions.

Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.

Flush Mounting: Mount characters with backs in contact with wall surface.

Projected Mounting: Mount characters at projection distance from wall surface indicated.

Cast-Metal Plaques: Mount plaques using standard fastening methods to comply with manufacturer's written instructions for type of wall surface indicated.

Concealed Mounting: Mount plaques by inserting threaded studs into tapped lugs on back of plaque. Set in predrilled holes filled with quick-setting cement.

Face Mounting: Mount plaques using exposed fasteners with rosettes attached through face of plaque into wall surface.

END OF SECTION 10 14 00 (10140)

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Corner guards.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long.
- C. Material certificates.
- D. Material test reports.
- E. Maintenance data.
- F. Warranty: Sample of special warranty.

1.3 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.

1.4 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. Surface-Mounted, Opaque-Plastic Corner Guards Fabricated from PVC plastic, acrylic-modified vinyl sheet or opaque polycarbonate sheet; with formed edges; fabricated with 90- or 135-degree turn to match wall condition; in dimensions and profiles indicated on Drawings.\
1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Boston Retail Products.
 - e. Construction Specialties, Inc.
 - f. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - g. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - h. Kwalu, LLC.
 - i. Musson Rubber Company.
 - j. Pawling Corporation.
 - k. Tepromark International, Inc.
 - l. WallGuard.com.
 - m. wallProtex.
 2. Mounting: [Double-faced adhesive foam tape].
 3. Color and Texture: As selected by Architect from manufacturer's full range]

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

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Toilet Accessories
 - 2. Bath Accessories
 - 3. Attachment hardware

1.2 REFERENCE STANDARDS

- A. [ASTM International](#) Publications:
 - 1. A167 “Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip”
 - 2. A666 “Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar”
- B. [American National Standards Institute \(ANSI\)](#)
 - 1. ICC/ANSI A117.1-2003 “Accessible and Useable Buildings and Facilities”
- C. Americans with Disabilities Act ([ADA](#)) II Public Accommodations
 - 1. [Americans with Disabilities Act Accessibility Guidelines \(ADAAG\)](#)

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data: Mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this project.

1.4 QUALITY ASSURANCE:

- A. Provide products of the same manufacturer for each type of accessory unit and for units exposed in the same area.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver accessories to site until rooms in which they are to be installed are ready to receive them.
- B. Store packages to prevent physical damage or wetting.
- C. Pack accessories individually in a manner to protect accessory and its finish.
- D. Maintain protective covers on all units until final clean-up.
- E. Protection: Protect adjacent or adjoining finished surfaces and work from damage during installation of work of this Section.

1.6 WARRANTY

- A. Work of this Section shall be jointly warranted by the manufacturer and the installer for a period of one year after final payment. Any material or workmanship that is judged defective during this period shall be replaced at no cost to the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Qualified Manufacturers:
 - 1. [WingIts LLC](#) (877-894-6448)
 - 2. [Moen](#) (800-289-6636)
 - 3. [Arcs & Angles](#) (212-625-6621)

2.2 MATERIALS - TOILET ACCESSORIES

- A. 18-8 (Type 302) stainless steel alloy of at least 22 gauge in all elements of cabinet work. Unless shown otherwise, all exposed stainless steel to have a #4 Satin finish or Satin chrome finish where applicable with all elements of a unit to have brushing in one direction.
- B. Exposed surfaces to be protected with a factory applied PVC film to be left in place until final clean-up.
- C. Mirrors to be 1/4" polished plate glass with 10-year guarantee against silver spoilage.
- D. Stainless steel tubing: 18 ga., Type 304, seamless welded.
- E. Fasteners, screws, and bolts: Hot dip galvanized. Expansion shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component substrate.
- F. Adhesive: Epoxy type contact cement.

2.3 FINISHES

- A. Refer to Toilet, Bath and Laundry Accessory Schedule for Finishes.
- B. Exposed heads of fasteners shall match finish of accessory.

2.4 FABRICATION - TOILET ACCESSORIES

- A. Provide steel anchor plates and anchor components for installation on building finishes.
- B. Form surfaces flat without distortion. Maintain flat surface without scratches or dents.
- C. Back paint components where contact is made with building finishes to prevent electrolysis.
- D. Hot dip galvanize ferrous metal anchors and fastening devices.
- E. Shop assemble components and package complete with anchors and fittings.

PART 3 EXECUTION

3.1 PREPARATION

- A. Deliver inserts and rough-in frames to job site and in appropriate time for building-in. Provide templates and rough-in measurements as required.
- B. Before starting work, notify [\[Architect\]](#) in writing of any conflicts detrimental to installation or operation of units.

- C. Verify with [Architect] exact location of accessories.

3.2 INSTALLATION

- A. Install fixtures, accessories, and items in accordance with manufacturer's printed instructions.
- B. Use concealed fastenings wherever possible.
- C. Install true, plumb, and level, securely and rigidly anchored to substrate in accordance with manufacturer's instructions for each item and each type of substrate construction.
 - 1. Wood blocking shall be provided at grab bars and fold down shower seats, and as shown on Drawings.
 - 2. Strap metal may be used for all other areas, as approved by [Architect], unless indicated otherwise.
- D. Fasteners for all accessory mountings to be theft-resistant.

3.3 ACCESSORY SCHEDULE

- A. Refer to Sheet A-530 for Toilet, Bath and Laundry Accessory Schedule.

END OF SECTION 10 28 00 (10800)

SECTION 10 44 13 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire Extinguisher Cabinets
 - 2. Portable Fire Extinguishers
- B. Related Sections:
 - 1. Division 9 painting Sections for field painting fire protection cabinets.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.
- D. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

1.5 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M Commercial Steel (CS), Type B.
- B. Stainless-Steel Sheet: ASTM A 666 Type 304.
- C. Acrylic Bubble: One piece.

2.2 FIRE EXTINGUISHERS

- A. Manufacturers: Provide products complying with requirements of contract documents and made by one of the following:
 - 1. Fire extinguishers:
 - a. Ansul Fire Protection/A Grinnell Company.
 - b. General Fire Extinguisher Corporation.
 - c. Walter Kidde, The Fire Extinguisher Co.
- B. Fire Extinguishers:
 - 1. Rating: 4A-60B: C, 10 pounds capacity.
 - 2. Type: Multipurpose dry chemical (ammonium phosphate).
 - a. Stored pressure type.

2.3 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Basis of design: Subject to compliance with requirements provide "Cameo Series C2409-6R"; Larsen Manufacturing Co. or comparable product.
 - 2. Basis of design: Subject to compliance with requirements provide "Cameo Series FS C2409-6R"; Larsen Manufacturing Co. or comparable product.
- B. Cabinet Construction: Nonrated and 2-hour fire rated.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- thick, cold-rolled steel sheet lined with minimum 5/8-inch- thick, fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Steel sheet.
- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
- E. Cabinet Trim Material: Painted steel sheet.
- F. Door Material: Painted steel sheet.
- G. Door Style: Full bubble with frame.
- H. Door Glazing: Molded acrylic bubble.
 1. Acrylic Bubble Color: Clear, transparent.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 1. Provide surface mounted door handle finished to match door with friction or roller catch.
 2. Provide continuous hinge of same material and finish as trim, permitting door to open 180 degrees.

2.4 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
 3. Prepare doors and frames to receive locks.
 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" or equivalent Indian institution for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. 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.

2.6 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturers written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 10 51 13 - METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Knocked-down, standard quiet metal lockers.
- B. Related Sections include the following:
 - 1. Division 06 Section "Interior Architectural Woodwork."

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show base and sloping tops and other accessories.
 - 2. Include locker identification system.
- C. Samples for Verification: For metal lockers in manufacturer's standard sizes.
- D. Qualification Data: For Installer.
- E. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative of metal locker manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain metal lockers and accessories through one source from a single manufacturer.

- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for metal locker installation.

1.6 COORDINATION

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

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS) Type B, suitable for exposed applications.
- B. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.
- C. Anchors: Select material, type, size, and finish required for secure anchorage to each substrate.

2.2 KNOCKED-DOWN, STANDARD QUIET METAL LOCKERS

- A. Basis-of-Design Product: Lyon Double Tier Quiet Locker.
- B. Locker Arrangement: Double tier.

- C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated, cold-rolled steel sheet with thicknesses as follows:
 - 1. Tops, Bottoms, and Intermediate Dividers: 0.0239 inch, with single bend at sides.
 - 2. Backs and Sides: 0.0239 inch thick, with full-height, double-flanged connections.
 - 3. Shelves: 0.0239 inch thick, with double bend at front and single bend at sides and back.
- D. Frames: Channel formed; fabricated from 0.0598-inch- thick, cold-rolled steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
- E. Doors: One-piece; fabricated from 0.0598-inch- thick, cold-rolled steel sheet; formed into channel shape with double bend at vertical edges, and with right-angle single bend at horizontal edges.
 - 1. Door Style: Vented panel as follows:
 - a. Louvered Vents: Not less than five louver openings at top and bottom for double-tier lockers.
- F. Hinges: Self-closing; welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
 - 1. Knuckle Hinges: Steel, full loop, 5 knuckles, tight pin; minimum 2 inches high. Provide not less than 3 hinges for each door more than 42 inches high.
- G. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.
 - 1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated with vinyl or nylon to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
- H. Equipment: Equip each metal locker with identification plate and the following, unless otherwise indicated:
 - 1. Double-Tier Units: one double-prong ceiling hook.
- I. Accessories:
 - 1. Finished End Panels: Fabricated from 0.0239-inch- thick, cold-rolled steel sheet.

2. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
3. Continuous Zee Base: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.
 - a. Height: 6 inches.

J. Finish: Baked enamel.

1. Color(s): As selected by Architect from manufacturer's full range.

2.3 FABRICATION

- A. General: Fabricate metal lockers square, rigid, and without warp; with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.
1. Form body panels, doors, shelves, and accessories from one-piece steel sheet, unless otherwise indicated.
 2. Provide fasteners, filler plates, supports, clips, and closures as required for a complete installation.
- B. Knocked-Down Construction: Fabricate metal lockers for nominal assembly at Project site using nuts, bolts, screws, or rivets. Factory weld frame members together to form a rigid, one-piece assembly.
- C. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- D. Shelf: Manufacturer's standard hat shelf.
- E. Identification Plates: Manufacturer's standard etched, embossed, or stamped aluminum plates; with numbers and letters at least 3/8 inch high.
- F. Legs: Formed by extending vertical frame members or by attaching gusset-type legs to locker body; with provision for fastening to floor; finished to match lockers.
1. Closed Front and End Bases: Fabricate bases without overlap or exposed fasteners; finished to match lockers.
- G. Continuous Sloping Tops: Fabricated in lengths as long as practicable, without visible fasteners at splice locations; finished to match lockers.
- H. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

2.4 STEEL SHEET FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.

- C. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.
- D. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion, using concealed fasteners.
 - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
- B. Knocked-Down Metal Lockers: Assemble knocked-down metal lockers with standard fasteners, with no exposed fasteners on door faces or face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach hooks with at least two fasteners.
 - 2. Attach door locks on doors using security-type fasteners.
 - 3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - 4. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit metal locker use during construction.

- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal locker manufacturer.

END OF SECTION 105113

SECTION 12 36 23 - PLASTIC COUNTERTOPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic Laminate
 - a. Countertops and Backsplashes
 - b. Aprons

1.2 REFERENCES

A. [American National Standards Institute \(ANSI\)](#) Publications:

1. A161.2 "Performance Standards for Fabricated High Pressure Decorative Laminate Countertops"
2. A208.1 "Particleboard"

B. [ASTM International \(ASTM\)](#) Publications:

1. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"

C. [Federal Specifications \(FS\)](#) Publications:

1. MM-L-736 "Lumber, Hardwood"
2. MMM-A-130 "Adhesive, Contact"

D. [National Electrical Manufacturer's Association \(NEMA\)](#) Standards Publications:

1. LD3 "High Pressure Decorative Laminates"

E. [National Institute of Standards and Technology \(NIST\)](#)

1. PS 1 "Construction and Industrial Plywood"
2. PS 20 "American Softwood Lumber Standard"
3. PS 51 "Hardwood and Decorative Plywood"
4. PS 58 "Basic Hardboard"

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:

1. Submit Shop Drawings and product data. Include materials, component profiles, fastening methods, assembly methods, joint details, accessory listings, and schedule of finishes.

1.4 QUALITY ASSURANCE

A. Perform work to (custom) quality in accordance with "Quality Standards" of the Architectural Woodwork Institute [AWI](#)

B. Plastic Laminate Materials shall comply with [NEMA](#) LD-3 as follows:

1. GP 50: Horizontal grade

2. CL 20: Cabinet liner
3. BK 20: Backing sheet
4. PF-40: Post Forming Grade
5. FR 50: Horizontal application, fire retardant material
6. FR 32: Vertical application, fire retardant material

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver countertops until painting and similar operations that could damage synthetic marble have been completed in installation areas. If countertops must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.
- B. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where countertop work is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 1. Locate concealed framing, blocking, and reinforcements that support countertops by field measurements before being enclosed and indicate measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 PLASTIC LAMINATE

- A. Plastic Laminate: Shall be standard grade, 1/16" thick, general purpose material complying with current [NEMA](#) LD-3 Grade HGS for flat countertops [and HGP for postformed]. Comply with [ANSI](#) A161.2. Pattern and color shown in [[Comfort Suites Interior Finish Specifications](#)].
 1. Qualified Manufacturers:
 - a. [Formica Corporation](#) (800-367-6422)
- B. Fire-Retardant Core:
 1. Shall be Particleboard, complying with [ANSI](#) A208.1, 45-lb. density, minimum 3/4" thick fire retardant type in accordance with [ASTM](#) E84 and the following:
 - a. Flame Spread: 25 maximum
 - b. Smoke Developed: 25 maximum
 - c. Fuel Contributed: 25 maximum
- C. Adhesives:
 1. Wood Glue: Waterproof types as recommended by [AWI](#) standards for the particular application.

2. Plastic Laminate Adhesive: Non-Flammable Type and as recommended by plastic laminate manufacturer:

- a. Qualified Manufacturers:

- 1) [DAP, Inc.](#) (888-327-8477)

2.2 COUNTERTOPS - KITCHEN

- A. Countertops and Edging: [\[3/4" B-C particleboard \(except at sinks, use exterior grade plywood only\)\] \[Fire-retardant particle board\]](#) with plastic laminate bonded to tops.

1. In locations as required by local codes or ordinances, provide fire retardant countertop assemblies, as tested in accordance with [ASTM E 84](#).

- B. Plastic Laminate Work:

1. Where shown as self edged, countertops shall have 3/4" x 4" high square-edged separate matching backsplash and matching aprons with same grade of laminate as top surface unless indicated otherwise.
 - a. Apply trim and edging prior to surface sheet.
 - b. Apply veneers or plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Make corners and joints hairline. Locate counter butt joints minimum 2 feet from sink cut-outs.
2. Counters and work tops with sinks: Substrate for back splashes and at edges shall be trimmed lumber. Use only exterior grade or marine grade Plywood near wet areas. All adhesives used near water shall be formulated to be specially water-resistant.

- C. ADA Accessible Guest Room:

1. Meet all local and national requirements for access. Minimum work surface shall be as follows:
 - a. Sink Area: Minimum 28" to 34" maximum above finished floor x 30" in length.
 - b. Countertop: Minimum 28" to 34" maximum above finished floor x 30" in length.
2. For units which have exposed sides and ends due to placement of accessible units, provide durable, nonabsorbent materials for finish.
3. Provide wall brackets and standards of the type capable of loads of 250 pounds per linear foot of horizontal work surface.
4. Provide brackets capable of supporting work surfaces and loads without leading edge deflection greater than 1/2".

2.3 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.4 FABRICATION

A. General:

1. Shop assemble countertops for delivery to site in units easily handled and to permit passage through building openings.
2. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trip for scribing and site cutting.
3. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings.

PART 3 EXECUTION

3.1 INSPECTION

- #### A. Verify adequacy of backing and support framing.

3.2 INSTALLATION

- #### A. All countertops and shelving shall be installed as shown on Drawings and as specified by manufacturer.
- #### B. Set and secure countertops in place rigid, plumb, and level.
- #### C. Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
- #### D. Fasteners:
1. Use purpose designed fixture attachments at concealed locations for wall-mounted components.
 2. Use threaded steel concealed joint fasteners to align and secure adjoining counter tops.
 3. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

3.3 PLASTIC LAMINATE

A. Installation:

1. The plastic laminate shall be bonded to a suitable substrate. Rigid setting type adhesive is recommended. The temperature of the materials, surfacing, substrate, and adhesive, and the area in which the actual fabrication is to be done shall not be less than 65 degrees F. with a relative humidity of not less than 35% and not more than 85%. All inside corners of cutouts in plastic laminate shall be radiused as large as possible with 1/8"R minimum. File edges of the radius smooth and free of cracks and crazes.

B. Method:

1. Assembly of components should be accomplished using approved procedures, materials, and equipment, and the workmanship should conform to established industry practices, conditions, procedures, and recommendations.
- C. Use single sheet at corners. Seams will not be permitted at corners, unless otherwise approved by Owner's representative.
- D. Arrange joints in vertical edges away from common view.

3.4 ADJUSTING AND CLEANING

- A. Clean surfaces of plastic laminate with a damp cloth or ordinary bar soap and water. Harsh abrasive cleansers shall not be used. Stubborn dirt may be removed with lacquer thinner, methylethyl Ketone, contact adhesive solvents or cleaner waxes.

END OF SECTION 12 36 23 (06415)

SECTION 12 36 40 - STONE 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. This Section includes stone countertops.
- B. Related Sections include the following:
 - 1. Division 7 Section "Joint Sealants" for sealing of joints.
 - 2. Division 6 Section "Interior Architectural Woodwork" for interior standing and running trim, casework, and counters.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Each variety of stone.
 - 2. Stone accessories and other manufactured products.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
- C. Samples for Verification:
- D. Qualification Data: For Installer.
- E. Sealant Compatibility Test Report: From sealant manufacturer, complying with requirements in Division 07 Section "Joint Sealants" and indicating that sealants will not stain or damage stone.
- F. Maintenance Data: For stone countertops to include in maintenance manuals. Include Product Data for stone-care products used or recommended by Installer, and names, addresses, and telephone numbers of local sources for products.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate stone countertops similar to that indicated for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of products.

- C. Source Limitations for Stone: Obtain each variety of stone from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
- B. Store stone on wood A-frames or pallets with nonstaining separators and nonstaining, waterproof covers. Ventilate under covers to prevent condensation.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of construction to receive stone countertops by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 GRANITE

- A. Granite: Comply with ASTM C 615.
- B. Description: Uniform, fine-grained stone.
- C. Finish: Polished.
- D. Color:

TBD

2.2 ADHESIVES, GROUT, SEALANTS, AND STONE ACCESSORIES

- A. General: Use only adhesives formulated for stone and ceramic tile and recommended by their manufacturer for the application indicated.
- B. Water-Cleanable Epoxy Adhesive: ANSI A118.3
- C. Water-Cleanable Epoxy Grout: ANSI A118.3, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.
 - 1. Color:

TBD

- D. Stone Adhesive: 2-part epoxy or polyester adhesive, formulated specifically for bonding stone to stone, with an initial set time of not more than 2 hours at 70 deg F (21 deg C).
- E. Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that comply with applicable requirements in Division 07 Section "Joint Sealants" and will not stain the stone it is applied to.
 - 1. Single-component, neutral-curing silicone sealant.
 - 2. Color: Clear.
- F. Stone Cleaner: Cleaner specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.
- G. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.

2.3 STONE FABRICATION, GENERAL

- A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.
 - 1. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically unpleasing, as judged by Architect.
- B. Grade and mark stone for final locations to produce assembled countertop units with an overall uniform appearance.
- C. Fabricate stone countertops in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.
 - 1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
 - 2. Cut and drill sinkages and holes in stone for anchors, supports, and attachments.
 - 3. Provide openings, reveals, and similar features as needed to accommodate adjacent work.
 - 4. Finish exposed faces of stone to comply with requirements indicated for finish of each type of stone required. Provide matching finish on exposed edges of countertops, splashes, and cutouts.
- D. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

2.4 STONE COUNTERTOPS

- A. General: Comply with recommendations in MIA's "Dimension Stone - Design Manual."
- B. Nominal Thickness: Provide thickness indicated.

- C. Edge Detail: Straight.
- D. Splashes: Provide backsplashes.
- E. Joints: Fabricate countertops without joints, if required, fabricate sections indicated for joining in field, with seams as follows:
 - 1. Bonded Joints: 1/32 inch (0.8 mm) or less in width.
- F. Cutouts and Holes:
 - 1. Undercounter Fixtures: Make cutouts for undercounter fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves. Ease juncture of cutout edges with tops, and finish edges to match tops.
 - 2. Counter-Mounted Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates indicated to receive stone countertops and conditions under which stone countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone countertops.

3.2 PREPARATION

- A. Advise installers of other work about specific requirements for placement of inserts and similar items to be used by stone countertop Installer for anchoring stone countertops. Furnish installers of other work with Drawings or templates showing locations of these items.
- B. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives. Allow stone to dry before installing.

3.3 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/16 inch in 48 inches (1.5 mm in 1200 mm).

- B. Variation from Level: Do not exceed 1/8 inch in 96 inches (3 mm in 2400 mm), 1/4 inch (6 mm) maximum.

3.4 INSTALLATION OF COUNTERTOPS

- A. General: Install countertops over plywood subtops with full spread of water-cleanable epoxy adhesive.
- B. Bond joints with stone adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- C. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Use power saws with diamond blades to cut stone. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- D. Install backsplash and end splash by adhering to wall with water-cleanable epoxy adhesive. Leave 1/16-inch (1.5-mm) gap between countertop and splash for filling with sealant. Use temporary shims to ensure uniform spacing.
- E. Grout joints to comply with ANSI A108.10. Remove temporary shims before grouting. Tool grout uniformly and smoothly with plastic tool.
- F. Apply sealant to seams and to gap between countertops and splashes; comply with Division 07 Section "Joint Sealants." Remove temporary shims before applying sealant.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace stone countertops of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
 - 2. Defective joints, including misaligned joints.
 - 3. Interior stone countertops and joints not matching approved Samples.
 - 4. Interior stone countertops not complying with other requirements indicated.
- B. Replace in a manner that results in stone countertops matching approved Samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. Clean stone countertops not less than six days after completion using clean water and soft rags. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- D. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions.

END OF SECTION 123640

SECTION 12 48 13 - ENTRANCE FLOOR MATS 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. This Section includes the following:
 - 1. Entrance mats in recessed frames.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for slab depression and for recessed mats and frames.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings.
- C. Samples for Verification: For each type of product indicated.
 - 1. Floor Mat: 12-inch- (300-mm-) square, assembled sections of floor mat.
 - 2. Tread Rail: 12-inch- (300-mm-) long Sample of each type and color.
 - 3. Frame Members: 12-inch- (300-mm-) long Sample of each type and color.
- D. Maintenance Data: For floor mats and frames to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain floor mats and frames through one source from a single manufacturer.
- B. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1.5 PROJECT CONDITIONS

- A. Field Measurements: Indicate measurements on Shop Drawings.

1.6 COORDINATION

- A. Coordinate size and location of recesses in concrete with installation of finish floors to receive floor mats and frames.

PART 2 - PRODUCTS

2.1 ROLL-UP MATS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide "Pedimat M1" as manufactured by Construction Specialties, Inc., or comparable product.
- B. Roll-up, Aluminum-Rail Hinged Mats: Extruded-aluminum tread rails 1-1/2 inches (38 mm) wide by 3/8 inch (9.5 mm) thick, sitting on continuous vinyl cushions.
 - 1. Tread Inserts: 1/4-inch- (6-mm-) high, 28-oz./sq. yd. (950-g/sq. m) weight, level-cut, nylon-pile, fusion-bonded carpet.
 - 2. Colors of Inserts: TBD
 - 3. Rail Color: Mill-finish.
 - 4. Hinges: Aluminum.
- C. Recessed Frames:
 - 1. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
 - 2. Color: Mill finish.
- D. Structural Performance: Provide roll-up mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform floor load of 300 lbf/sq. ft. (14.36 kN/sq. m).
 - 2. Wheel load of 350 lb (159 kg) per wheel.

2.2 CONCRETE FILL AND GROUT MATERIALS

- A. Provide concrete grout and fill equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

2.3 FABRICATION

- A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's

recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

- B. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.
- C. Coat surfaces of aluminum frames that will contact cementitious material with manufacturer's standard protective coating.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.
 - 1. Install necessary shims, spacers, and anchorages for proper location and secure attachment of frames.
 - 2. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

3.3 PROTECTION

- A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

SECTION 13 11 00 - SWIMMING POOLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Equipment specification as a basis of design salt and water system. Please inform architect of any substitution.
- B. Section Includes:
 - 1. Pool Constructed of Gunite and Shotcrete System.
 - a. The Pool Contractor shall be responsible for design and installation of indoor pool and spa system.
 - 2. Pool Contractor shall be responsible for submitting and securing necessary approvals and permits, including payment of fees, and expenses for the preparation of any required documentation.
- C. Related Sections:
 - 1. Section 093000 - Ceramic Tiling
 - 2. Division 22 and 26 Specifications for the following:
 - a. Excavation for electrical and plumbing lines.
 - b. Pool deck hose bibs.
 - c. Cold water supply within pool equipment room.
 - d. Gas line for pool heaters.
 - e. Conduit wiring, receptacles and disconnects to the pool equipment room.
 - f. Pool heater flues.
 - g. Filter room, decks, sealing of joints between pool and deck, shall be provided as work of other sections.
 - h. Connection of floor & deck drains and hose bibs is specified in Division 22.
 - i. Connection of pool heater to gas source and heater vent piping in equipment room shall be performed by Contractor.
 - j. Provisions for combustion air.
 - k. Connection of automatic water fill system and fill spout cold water lines from water source in equipment room is specified in Division 22.
 - l. Connection of all pool equipment, starters and switches; grounding of pool, pool equipment, pool lights and niches, and wiring of pool & spa lights from electrical panel in equipment room is specified in Division 26.
 - m. On Projects that include emergency generator, the underwater pool niche lights shall be connected to emergency power.
 - 3. Section 312000 – Earthwork

1.2 REFERENCES

- A. Applicable requirements of the following Specifications and Codes apply to work of this Section:
1. National Spa and Pool Institute (NSPI): Minimum Standards for Public Swimming Pools.
 2. Local building and health codes.
 3. National Electrical Code (NEC).
 4. National Sanitation Foundation (NSF): Seal of approval program.
 5. Gunitite Contractors Association (GCA): Technical Publication G-84, entitled Gunitite and Shotcrete.
 6. American Society for Testing and Materials (ASTM): Specifications referenced herein.
 7. American Society of Mechanical Engineers (ASME) Coding and Labeling.
 8. Tile Council of America, Inc. "Handbook for Ceramic Tile Installation".

1.3 SYSTEM DESCRIPTION

- A. System shall include:
1. Provide systems of fully compatible components and construction methods required for complete and operable systems for indoor swimming pool including but not limited to excavation, dewatering of construction area and removal of excess earth from site.
 2. Gunitite and shotcrete shell.
 - a. Finish Plaster Mix (Diamond Rite).
 3. Excavating, hauling, backfilling, grading and incidental earthwork in conjunction with the construction of the swimming pool.
 - a. Handle and dispose of excess material, regardless of type, character, or composition.
 4. Connections of water and gas to pool equipment
 5. Connection of motors, pumps, compressors, switches and timers, lights, and wiring necessary for interfacing of equipment.

6. Pool Equipment.
 - a. Filter Systems
 - b. Flow Meters
 - c. Water Treatment Systems
 - d. Heaters
 - e. Recirculation Pumps and Motors
 - f. Piping
 - g. Fittings, Lights and Accessories
 - h. Deck Drain System
 - 1) Automatic Water Fill System and Fill Spout

1.4 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 013300 and with the following supporting data:
 1. Product Data:
 - a. Manufacturer's technical literature with installation and storage instructions for each product specified.
 - b. Pumps: Pump performance curves indicating GPM vs. TDH, maximum efficiency point, and maximum amperage draw, together with current characteristics and service factor of motor.
- B. Shop Drawings
 1. Submit the following Shop Drawings to the Owner's Agent for approval:
 - a. Complete design of swimming pool, including all component parts, attachments, devices, or other work, filtration filter, size, turn-over capacity, and supporting calculations.
 - b. Foundation plan and details and Sections through pool shall be included.
 - c. Mechanical schematic.
 - d. Detail for ladder and pool wall interface.
 2. Show all shop erection details.
 3. All Shop Drawings shall be certified and sealed by a Professional Engineer, registered in the state in which project is being submitted.
 4. The pool manufacturer shall certify to the Owner that the depth and configuration of the pool is acceptable and compatible with all known safety standards for the manufacturer's designed product.
- C. Samples:
 1. Precast concrete pool coping deck, One-12" long section of coping, complete with stenciled depth marking.

2. Submit three (3) samples of each type and color of tile required.

D. Quality Control:

1. Design Data:

- a. Hydraulic analysis: Engineer's sealed calculations and total dynamic head (TDH) for swimming pool system for equipment other than that specified.
- b. Structural analysis: Engineer's sealed calculations and analysis for pool concrete design.

E. At the completion of the work, the Pool Contractor shall furnish to the Owner two bound copies of an operation manual. Minimum content of these manuals shall be:

1. Operating Instructions
2. Equipment Literature with Parts List of all Equipment
3. Water Chemistry Procedures
4. Suggested Safety Procedures
5. Repainting/Refinishing Procedures
6. Include chemical analysis of source/make-up water supply
7. Copies of all manufacturer's warranties
8. Test reports
9. Sealed Engineer's drawings.
10. Certificates: From local authorities indicating that pool construction and performance conform to requirements of respective authorities.

F. At the completion of the work, the Pool Contractor shall fill the pool with water and instruct the Owner's operating personnel in the operation of all equipment.

G. The Pool Contractor shall test the Owner's natural water supply and furnish and supply start-up chemicals as required for start-up, including chlorine and requirements to balance total alkalinity and calcium hardness, and shall obtain same.

1.5 QUALITY ASSURANCE

A. All work under this Section must be performed by a Contractor experienced and regularly engaged in building, commercial swimming pools. Contractors bidding this work must have completed five (5) projects within the past ten years equal to or larger than this project.

- B. Pool specification and related pool drawings are to be considered as performance guidelines only meeting minimum requirements which may change as result of local code and health department requirements.
 - 1. The project Drawings and Specifications supplement each other. In the event of a conflict, the Specifications shall govern. Piping locations are schematic. Precise locations of piping shall be determined by actual field condition. Fittings are not shown. The Pool Contractor shall include all fittings normally required for a completed system.
 - 2. This Contractor shall be responsible for reviewing the complete set of Contract Documents and coordinate work with other trades.
- C. All work under this Section shall be inspected and installed in accordance with all current local and state codes and regulations.
 - 1. The Pool Contractor shall obtain the following:
 - a. Board of Health Design Approvals
 - b. State Board of Health Inspections and Final Approval
 - c. Structural and Electrical Inspections and Final Approvals on his Portion of the Work
- D. The standards of these Plans and Specifications are intended to provide the Owner with a low maintenance pool.
- E. Pool Contractor to be responsible for design and installation of pools, including layouts, routing of piping, as well as the proper location and quantities of required accessories. Responsibilities also include necessary valves, devices, and controls for pool system as required.
- F. Contractor's design drawings must be sealed and signed by a licensed Engineer registered in State in which project is being constructed.
- G. Contractor shall submit, on his letterhead, a list of all variations and deviations he finds that differ between local code requirements and bid drawings.

1.6 PROJECT CONDITIONS

- A. Coordination: Coordinate this work with the work of other Sections to avoid any delay or interference with other work.
 - 1. Filter room, decks, sealing of joints between pool and deck, fencing and landscaping shall be provided as work by other Sections.
 - 2. Connection of all pool equipment, starters and switches; grounding of pool, pool equipment, pool lights and niches, and wiring of pool lights shall be performed by Pool Subcontractor from electrical panel in equipment room.
 - 3. Connection of floor drains, deck drains and hose bibs shall be provided as work of other Sections.

4. Connection of pool heater to gas source and heater vent piping in equipment room shall be performed by Mechanical Contractor.
5. Provisions for combustion air will be provided as work by other Sections.
6. Connection of automatic water fill system and fill spout cold water lines from water source in equipment room shall be performed by Pool Subcontractor.

B. Lines, Grades, and Elevations:

1. The General Contractor shall establish a bench mark for elevations and control points for measurements and layouts. The Pool Contractor shall be responsible for lines, grades, and measurements from these points required for the installation of the pool.

C. Utilities:

1. The Contractor shall supply the water required for construction and filling and testing of the pool from permanent accepted system.

1.7 WARRANTY

- A. The Pool Contractor shall warranty his work against defects in labor and equipment, including paint, for a period of one year from Substantial Completion. Substantial Completion shall be defined as the date of acceptance by the Owner or initial usage, whichever occurs first. This warranty shall not include minor defects that do not affect the use of the pool such as scratches, minor dents, or concrete curing cracks.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: The following manufacturers are approved for use as identified in the individual paragraphs below:

A. Approved Manufacturers:

1. A & B Brush
2. Action/Haviland (800-333-0400)
3. American Olean Tile Co. (800-933-8453)
4. American Products
5. Anchor Industries, Inc. (800-544-4445)
6. Berkeley (Sta-Rite Water Systems) (888-237-5353)
7. Bio-Lab, Inc. (800-959-7946)
8. Blue White Industries (714-893-8529)

9. Cal-June, Inc. (818-761-3516)
10. Dal-Tile Corp. (800-933-8453)
11. Degroot Studios (954-587-5487)
12. Federal Stone Industries, Inc. (800-513-5030)
13. Frost Co. (Inter-Fab) (800-737-5386)
14. A. J. Giammanco & Associates, Inc. (Lion Pool Products) (800-546-6766)
15. Gould Pumps, Inc (315-568-2811)
16. Grace Construction Products (800-778-2880)
17. Guardex (Bio-Lab) (800-959-7946)
18. Halogen Supply (800-777-7946)
19. Hydrotech (Bio Lab). (800-795-7946)
20. Jandy (707.776.8200)
21. Lochinvar Corp. (615-889-8900)
22. Mameco International, Inc.; a Division of Tremco, Inc. (800-321-6412)
23. Mec-O-Matic (Pulsafeeder) (800-333-6677)
24. Mortex Manufacturing, Inc. (800-338-3255)
25. Omni (Div. Bio-Lab) (800-959-7946)
26. PAC-FAB, Inc. (see Paragon Aquatics) (800-983-7665)
27. Paragon Aquatics, a division of PAC-FAB, Inc. (914-452-5500)
28. Pentair Pool Products (800-843-5628)
29. Purex (see Pentair Products)
30. Quaker Plastic Corporation (888-288-6644)
31. Rainbow (845-8906-8320)
32. Raypak, Inc (818-889-1500)
33. George Fischer Signet Scientific Co. (800-854-4090)
34. S. R. Smith Commercial (888.677-7776)

35. Spectrum Aquatics (800-776-5309)
36. StaRite Pool and Spa Group a Pentair Company (800-843-5628)
37. Stenner
38. Swimquip (See Sta-Rite Pool Spa Group) (800-752-0183)
39. Taylor Technologies. (800-837-8548)
40. Telodyne Laars (415-382-8220)
41. Whitten (Aquatic Development Group) (518-783-0038)
42. W. R. Meadows, Pool Deck Construction Products (800-542-7665)
43. VAK PAK (800-877-1824)

2.2 POOL STRUCTURE - GENERAL

- A. Size of pool shall be as shown on Drawings.
- B. Joint sealant shall be polyurethane, Mameco Vulkem No. 45.
- C. Ceramic Tiling: Tile used in conjunction with surfaces in contact with water shall be furnished and installed by pool Contractor.
- D. Perimeter and general purpose sealants shall be polyurethane, refer to Section 079200.

2.3 POOL MATERIALS

- A. Concrete:
 1. Definitions:
 - a. Gunite: Dry-mix. Originally a trade name used to designate a mixture of Portland cement and sand thoroughly mixed dry, passed through a cement gun and conveyed by air through a flexible tube, hydrated at the nozzle and placed by air pressure.
 - b. Shotcrete: Wet-mix. transit-mix (ready-mix) combination of Portland cement, aggregates and water, pumped in a plastic state to the nowle, where air is added to place the material.
 2. Materials and mixes for "Gunite" and shotcrete shall conform to GCA publication G-84.
 3. Gunite:
 - a. Aggregate: ASTM C 33, washed sand; clean, hard, sharp particles, well graded in size within the following limits:

<u>Size</u>	<u>Percent by Weight</u>
Passing through 3/8 inch screen	100
Passing through No. 4	95 to 100
Passing through No. 8	65 to 90
Passing through No. 16	45 to 75
Passing through No. 30	30 to 50
Passing through No. 50	10 to 22
Passing through No.100	2 to 8

b. Mix one part cement to 4 1/2 parts of sand based on dry, loose volume (minimum 3,000 psi compressive strength in 28 days).

c. Portland cement and water: As specified hereinafter.

4. Shotcrete:

a. Transit mix (ready-mix) materials conforming to aggregate specified above for "Gunite" and with the additional following grading for pea gravel:

<u>Sieve Size</u>	<u>Percent by Weight</u>
1/2"	100
3/8"	90

b. Mix Strength: Minimum 5,000 psi compressive strength in 28 days.

c. Submit design mix and certify material for weight, water content and mixing time.

d. Portland Cement and Water: As specified hereinafter.

5. Portland Cement: ASTM C150, Type I or II.

6. Water: Potable.

7. Forms: Exterior plywood, APA-B8 Plyform Class 1, mill-oiled.

8. Form Oil: Lacquer or resin type compatible with mill-oil.

9. Reinforcing Steel: ASTM A615 grade 40.

10. Gauging Wires: Piano wire, 0.027" thick.

B. Ceramic Tiling:

1. Unglazed Ceramic Mosaic tile at Step Nosings:

a. Approved Manufacturers:

- 1) Dal-Tile Corp
- 2) American Olean Tile Co.

2. Provide certification by manufacturer for use in pools.

3. Refer to Drawings and Interior Finish Index for size and location. 2" x 2" at water line below coping cap. See Drawings for location of special 8" x 8" tile with 6" high silk screened depth marking in feet and inches as required by local and state public swimming pool codes. Adjacent to each depth marker, provide international symbol "No Diving" sign tile. "No Diving" tile shall be 8" x 8" for skim-line and 8" x 8" for deck (non-slip) white ceramic with black lettering and markings and a red circle with cross hatch.
4. Depth marking and no diving tiles shall be placed on the vertical pool walls as part of the 8" tile band below the coping so as to be easily readable from the water side. Depth marking and "No Diving" tiles on the horizontal surface of deck, shall be within 18" of the water edge and positioned to be read while standing on the deck facing the water. Pool markings shall be placed at maximum and minimum depths, all points of slope change, and at even foot of depth increment. Markers shall be spaced at no more than 25 foot intervals and arranged to be uniformly located at the ends and sides of the pool.
5. 2" x 2" non-slip unglazed ceramic mosaic tile in color as shown in Interior Finish Index at step nosings forming a 2" horizontal and 2" vertical band.
6. Tile Mortar and Grout: As specified in Section 093000 - Ceramic Tiling.
7. Refer to Interior Finish Index for colors.

C. Finish Plaster Mix:

1. White marble, White waterproof cement and bonding agent.
2. Approved Manufacturers:
 - a. "Diamond Brite" Pool Finish; SGM
 - b. No Substitutions
3. Finish and Color: Selected by Architect.

D. Sealant and Back-Up Material: See Section 079200 - Joint Sealants

E. Precast Concrete Pool Coping:

1. Precast concrete, wet pour, white, 12" wide x minimum 2' long bull nosed coping stone with raised slip resistant pattern on upper surface. Provide one-piece radius corners.
2. Provide bonding coat as recommended by finish manufacturer.

2.4 FILTER SYSTEM

A. Pressure Filters:

1. Approved Manufacturers:
 - a. Pac-Fab
 - b. Sta-Rite Pentair

2. Filter systems: Listed as approved by the National Sanitation Foundation for sand filters at flow rates of 20 GPM per square foot of filter area, and bear the National Sanitation Foundation Seal of Approval. Maximum filter flow rate shall not exceed 15 GPM per square foot of filter area.
 3. Filter or Filter Battery Stainless steel or fiberglass hi-rate pressure sand filters.
 4. Include with each filter top mounted influent pressure gauge, reading 0 to 60 psi, manual air release valve, multi-port diameter valve, backwash site glass and transparent dome top.
- B. Filter Media: Sand, with an effective size of 0.45 to 0.55 mm with uniformity coefficient of 1.6 maximum.
- C. Filter Face Piping:
1. Pipe, valves, and fittings shall make a complete unit or battery from inlet to outlet.
 2. Arrange piping to carry out operations of filtering, backwashing and by-pass of filter for pool draining.
 3. Face pipe and fittings: PVC SCH 40.

2.5 FLOW METERS

- A. Flow Meter:
1. Approved Manufacturers:
 - a. Pac-Fab
 - b. Sta-Rite
 - c. "CF-300 Series; Blue White Industries, pilot tube type.
 - d. Approved Substitution by Signet Scientific Co.

2.6 WATER TREATMENT SYSTEM

- A. Chemical Feeder:
1. Approved Manufacturers:
 - a. "Model 25163000"; Hydrotech
 - b. Approved Substitution by Omni
 - c. Approved Substitution by Guardex
 - d. Approved Substitution
 2. Include in-line flow meter, flow control valve, clear dome top and shut-off valves on both sides of feeder.
 3. Quantity: One at pool.

B. Chemicals:

1. Approved Manufacturers:
 - a. "SpaBrom" bromine sticks - Hydrotech 20 lb.
 - b. Approved Substitution

C. Test Kit:

1. Approved Manufacturers:
 - a. "#K-1744-H"; Taylor Technologies
 - b. "#26122000"- "Guardex" Bio-Lab.
 - c. Approved Substitution

2.7 POOL HEATERS

A. Pool Heaters:

1. Teledyne Laars
2. Raypak
3. Approved Substitution.

B. Heaters:

1. Size for pool as shown on the Drawings, complete. Design based on maintaining a temperature of 80 degrees F for pool and 104 degrees F for spa.
2. Heaters must be A.S.M.E. coded and labeled.

C. Furnish in-line thermometer with 2 degrees F. intervals and a minimum range of 60-120 degrees F.

2.8 RECIRCULATING PUMP AND MOTOR

A. Pumps:

1. Approved Manufacturers:
 - a. Pac-Fab
 - b. StaRite Pentair
 - c. Approved Substitution
2. Self priming unit with hair and lint strainer capable of delivering the designated GPM at the designated head during the filtering operation without overloading along the full length of the pump curve.

B. Pump Motors:

1. Energy efficient, UL listed "E-plus Century"; Gould Pumps, Inc.
2. Electrical Characteristics: As shown on Drawings

2.9 PIPING

- A. Piping within filter room: Polyvinyl chloride (PVC), Type 1-1220, Schedule 40 IPS, Class #135. N.S.F. approved and labeled.
- B. Pool fill line: Schedule K copper.
- C. Filtered water supply piping to pool: Schedule 80 PVC. N.S.F. approved.
- D. Filter connection piping which connects the filter plant to the filter pump and to the recirculation piping, backwash piping and other piping associated with filter system: PVC, Type 1-1220, Schedule 40 IPS, Class #135. N.S.F. approved and labeled.
- E. Fittings for PVC pipe: Whenever PVC pipe is used, all fittings shall be heavy weight, Schedule 40, of same manufacture as PVC pipe used.
- F. NOTE: The first 24" of piping coming from pool heater shall be copper. Where the copper connects to PVC piping, after the 24", provide a copper to PVC transition connection.
- G. Valves:
 1. Small Valves (up to and including 2-1/2" in size): Gate valves, all brass with threaded ends for ferrous pipe, 125 lb. non-rising stem type.
 2. Large valves (larger than 2-1/2"): Rubber lined, cast iron, water type butterfly valves. Valves shall be hand operated with cadmium plated ductile iron discs, stainless steel stems and pins, and Buna-N seats and rated for 125 psi.
 3. Valve extension stems and keys: Provide as required to operate the system.
 4. Pipe identification: Plastic tags for valves in filter room.
- H. Pipe Joints:
 1. Cement and thinners: Use for making solvent welded joints. Of type compatible with kind of piping used.
 2. Teflon tape (.003" min thickness): Use on the male threads of threaded pipe joints.
- I. Fillers and levelers: Provide instrumentation sensors and valves to automatically fill and maintain level of pool complete with wiring and controls.
- J. Chemical feed and heater controls: Provide instrumentation sensors and valves to automatically feed chemicals and maintain temperature of pool complete with wiring and controls.

2.10 SCHEDULES OF POOL FITTINGS' LIGHTS AND EQUIPMENT ACCESSORIES

<u>Description</u>	<u>Manufacturer</u>	<u>Model Number</u>
A. Pool Fittings		
1. Floor Inlet	Frost	A-41014
2. Pool Wall Inlet	Swimquip	8429
3. Auto Water Level Control	Mar-Max	LTC 0024S
4. 1-1/2" Hydrostat Valve	Frost	A-41452
5. 1-1/2" Hydrostat Tube	Swimquip	7017-157
6. 1-1/2" Skimmer	American Prod	844201
7. 1" Fill Spout	Frost	A-41240
8. Pool Main Drain Sump	Swimquip	7017-0103
9. Pool Main Drain Grate	Swimquip	7010741
B. Underwater Lights: (Coordinate with Section 16510(26 51 00))		
1. 100W/300W/12V Light (Two)	Pac-Fab	PHL-301/PHL-300
2. Light Niche	Pac-Fab	425.4
C. Deck Fittings:		
1. Grab Rail, 1.90-1/2" OD x .065 Stainless Steel with smooth grip finish	S. R. Smith	
2. Deck Anchor	S. R. Smith	AS-100B
3. Escutcheon Plate	S. R. Smith	IEP-100
4. Ladder 3 tread 1.90" OD x .065" Stainless Steel with mirror finish. Provide every 75' at perimeter	S. R. Smith	SRS 506
D. Maintenance Accessories:		
1. Vacuum Cleaner Head Swivel Wheel	Rainbow	Flex-A-Vacuum
2. Vacuum Hose Heavy Duty	Action/Haviland	1-1/2" x 35'
3. Vacuum Pole (Telescopic 8' to 16')	Rainbow	#812-16 (8'-16')
4. Utility Pole	Frost	A40177-2
5. 18" Curved Wall Brush	A&B Brush	3000
	Spectrum	13210
6. Algae Brush	A&B Brush	2004
	Spectrum	13260/13270
7. Pole Adapter	Frost	A-41420 w/Brass Bolts & Wing Nuts
8. Deck Swab	Halogen Supply	48" CR Rubber
9. Brush Stabilizer	A&B Brush	Water Foil
E. Safety Accessories:		
1. Life Buoy (24" Approx.)	Cal-June, Inc.	U.S.C.G.
2. Throw Line (60, min.) w/ Floating Ball	AJ Giammanco	#60"
3. Life Hook	Rainbow	#153 Double Arm (R221026/R221030
4. Life Hook Pole	Rainbow	820-16 (R191116)

- | | | |
|---------------------------|-------|--|
| 5. Life Hook Pole Adapter | Frost | A-14420 w/Brass
Bolts and Wing Nuts |
| 6. Spine Board w/Ties | | |
| 7. 16 Unit First Aid Kit | | |

2.11 DECK DRAIN SYSTEM

A. Deck Drain System.

1. Approved Manufacturers:

- a. "Deck-O-Drain", W. R. Meadows, Pool Deck Construction Products (800-542-7665)
- b. "Deck Drain-A-Way System II", Quaker Plastic Corporation (888-288-6644)
- c. "Drain Rite" Mortex Manufacturing (800-338-3255)
- d. Approved Substitution

B. Material:

1. Heavy wall, bondable, non-corrosive PVC
2. Provide all nailing clips, couplers and fittings, end adapters, clean-out plugs and protective tape over drain surface.

C. Size: +/- 1-1/2" x 3-1/4" high x min. 8 ft. lengths, Center Channel.

D. Color: As selected by Architect.

2.12 HANDICAPPED LIFT

A. Handicapped Lift:

1. Approved Manufacturers:

- a. "Swim-Lift Series, Model Elkhorn"; Spectrum Pool Products
- b. "Model WC-702"; Whitten (Aquatic Development Group)
 - 1) "Model WC-HSP-3R, cast floor sleeve.
 - 2) "Model WC-HSP-5", Swimming Pool Extension Arm.
 - 3) "WC-112-D", Seat, chains, 24" swivel bar, and components
- c. Approved Substitution

B. Hydraulic therapy lifter, stainless steel frame with a capacity to support 400 pounds with the horizontal arm fully extended.

C. Provide lifter and all components required for a complete and operational installation. Provide sleeves in deck at pool.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas in which work is to be performed. Report in writing to Architect all prevailing conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Starting work constitutes acceptance of the existing conditions and this Contractor shall then, at his expense, be responsible for correcting all unsatisfactory and defective work encountered.

3.2 PREPARATION

- A. Perform earthwork and dewater excavation in compliance with Section 312000 - Earthwork. Remove excess earth from site if required and as directed by the Owner's Representative.
- B. Trench for system as specified in Section 312000 - Earthwork and provide system as specified in Section 330000 - Utility Services.

3.3 INSTALLATION

- A. Formwork and Reinforcement:
 - 1. Install form work to lines and profiles shown. Brace forms for work to prevent movement during concrete placing operations.
 - a. Allow other trades sufficient time for installation of equipment and materials which must be fastened to forms.
 - b. Clean form surfaces prior to concrete placing operations.
 - 2. Place reinforcing steel as shown on drawings. Steel shall be free from dirt' rust' oil, paint and mill scale.
 - 3. Securely wire-tie steel at points where bars cross. Stagger splices and laps.
 - 4. Install gauging wires to establish thickness of finish work.
 - 5. After placing pool reinforcing, but before placing concrete, confirm that grounding circuits have been provided by the electrical contractor to steel reinforcement, grab rails, and hand rails, as required by the National Electrical Code, Article 680. No concrete shall be placed until this requirement has been complied with.
- B. Concrete:
 - 1. Placing of "Gunitite" and shotcrete: Conform to the requirements of GCA publication G-84 and as specified herein.
 - 2. Gunitite:

- a. Mixing: Mix dry in batch mixing machine for a period of not less than 1 minute.
 - b. Mix and strength: As specified in Part 2.
 3. Shotcrete
 - a. Mixing time: Mixing time for materials delivered by ready-mix trucks to job site, shall not exceed two hours or 250 revolutions of drum, whichever comes first. Additional water may be added at job site only if requested by Contractor. When additional water is added, rotate drum minimum of 30 additional revolutions.
 4. Placing Concrete:
 - a. Place concrete against original undisturbed soil, thoroughly compacted earth.
 - b. Remove all loose, fine aggregate or rebound from surfaces receiving concrete before placing succeeding layers. Whenever possible, first layer shall entirely cover reinforcing steel to secure it in proper position.
 - c. Where new concrete is applied against existing concrete, thoroughly clean the existing surface and drench with water at least twice on the day before placing new concrete. Surfaces upon which concrete will be applied shall be sufficiently damp to prevent excessive absorption of water content in new concrete mix, but not so wet as to overcome suction.
 - d. Concrete deposited on vertical surfaces shall be shot at right angle to surface starting at the bottom and continuing upward. Build up in layers of a thickness that will not slump, allowing sufficient time between placing of layers for initial set to take place.
 5. Finishing:
 - a. When thickness and planes outlined by forms and gauging wires have been reached, rod surfaces to true lines. After rodding, remove gauging wires. Finish all exposed surfaces to straight and true lines.
 - b. Finish: Gun finish as left by nozzle.
 6. Continuously moisture cure for no less than 7 days.
- C. Equipment:
1. Flow meters: Install in straight run of pipe having minimum length of 10 pipe diameters upstream and 4 pipe diameters downstream and in position that can be easily read by operator.
 2. Chemical Feed injection: Locate Injection points downstream from all filter room equipment.
- D. Deck Drain System:
1. Install deck drain system in strict accordance with manufacturer recommendations and written instructions.

2. Grade subsoil, sloping it toward drain location. Drive 3-1/2" short stakes into ground at 30" o/c – two nailing strips per 10 ft. section. Attach nailing clips and place drain over the stakes. Use couplers to ensure a straight even line. After aligning, nail firmly to stakes.
3. Insert adapter. Install Clean-out. Place concrete and trowel gradual (min. 1/4"/ft.) slope to drain. After concrete has set, install end plug.
4. Coordinate removal of protective tape with deck finish coating application.

E. Piping:

1. Cut all pipe with mechanical cutter without damage to pipe.
2. Placing and Laying: Inspect pipe for defects before installation. Clean the interior of pipe thoroughly of foreign matter and keep clean during laying operation. Pipe shall not be laid in water or when trench conditions are unacceptable as determined by the Owner's Representative. Water shall be kept out of the trench until the pipe is installed. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other substance will enter the pipes or fittings.
3. Threaded Joints: After cutting and before threading the pipe shall be reamed and shall have burrs removed. Screw joints shall be made with graphite or inert filter and oil or with an approved graphite compound applied to male threads only. Threads shall be full-cut and not more than 3 threads on the pipe remain exposed. Use Teflon 11 tape on the male threads of all threaded pipe joints. Caulking of threaded joints to stop or prevent leaks will not be permitted. Unions shall be provided where required for disconnection of exposed piping. Unions will be permitted where access is provided.
4. Solvent welded joints shall be made in accordance with the manufacturer's printed instructions and the following minimum standards:
 - a. Fittings shall fit easily on the pipe before applying cement. The outer surface area of pipe and inner wall of fitting shall be dry and dean. Thinner is to be applied to the outer surface of the pipe and to the inner surface of the fitting. Cement is to be applied to the outer surface of the pipe, or on the male section of fittings only. When the outside surface area of the pipe is satisfactorily covered with cement allow ten (10) seconds open time to elapse before inserting pipe end into fitting. After full insertion of pipe into fitting, turn fitting about the pipe end approximately 1/8 to 1/4 of a turn. Wipe off excess cement at the joint in a neat cove bead.
 - b. Joints shall remain undisturbed for a minimum of 10 minutes from time of jointing the pipe and fitting. If necessary to apply pressure to a newly made joint, limit to 10% of rated pipe pressure, during the first 24 hours after the joint has been made.
 - c. Full working pressure shall not be applied until the joints have set for a period of 24 hours.
 - d. Make provisions for expansion and contraction by way of swing joints or snaking.
 - e. Protect plastic pipe from exposure to aromatic hydro-carbons, halogenated hydra carbons, and most of esters and ketones that attack the material. Protect all pipe from mechanical damage and long exposure to sunlight during storage.

5. Install piping without cross connections or inter-connection between distribution supply for drinking purposes and swimming pool that will permit backflow of water into potable water supply. Pipe openings shall be closed with caps or plugs during installation. Equipment and pool fittings shall be tightly covered and protected against dirt, water and chemical or mechanical injury. At completion of work fittings, materials and equipment shall be thoroughly clean and adjusted for proper operation.
 6. Filter Face Piping: Arrange to carry out operations of filtering backwashing and filter draining.
 7. Valve identification: Label all valves.
 8. Testing and Flushing:
 - a. Pressure Piping: After the pipe is laid, the joints completed, and the trench partially backfilled leaving joints exposed for examination, subject new lines to a hydrostatic pressure of not less than 50 pounds per square inch. Joints shall remain watertight under this pressure for a period of two hours.
 - b. Gravity Lines: A water test shall be applied to all gravity drain piping system, either in their entirety or in sections. All openings shall be tightly plugged and each system filled with water and tested with at least a 10 foot head of water. Water shall be kept in the system, or in the portion under test's for at least 15 minutes before inspection starts. System shall be tight at all joints.
 - c. Flushing: Pipelines leading to the pool shall be thoroughly flushed clean with chlorinated water before the pool is filled and placed in use.
- F. Plaster Finish:
1. Finish concrete surfaces in pool with a wood float finish to a smooth consistent finish acceptable to Owner Representative.
 2. Fill uneven surfaces and depressions with manufacturer's recommendations .
 3. Wash all pool surfaces thoroughly with dilute solution of muriatic acid and flush with fresh water to assure a clean surface free of loose materials, dust, and foreign matter.
 4. Plaster installation:
 - a. Apply in accordance with manufacturer's installation instructions.
 5. Trowel to smooth, dense, impervious surface free of stains and uniform white color consistency.
 6. Fill pool as plaster work progresses.
- G. Tile Installation: Where shown on Drawings, use setting materials and grout in accordance with Section 093000.

3.4 FIELD QUALITY CONTROL

A. For Gunit Shotcrete Work:

1. Compressive strength test: Take 1 sample for pool floor construction and 1 sample for wall construction but no less than a minimum test for each 50 cu. yd. of concrete.
2. Submit copy of test results to Owner's Representative.

B. Water Treatment

1. Obtain a chemical analysis of the source/make-up water supply and submit to Owner's Representative. Include the following:
 - a. Total alkalinity/ppm
 - b. Calcium hardness/ppm
 - c. Chlorine/ppm
 - d. pH
 - e. Iron
 - f. Copper
2. Treat and balance pool water prior to turnover of pool to Owner's Operations Division.
3. Balance water to establish:

Total alkalinity:	80-100 ppm
Calcium hardness:	20~275 ppm
Total Available CHL (Pool):	1.5 ppm
Free Available CHL (Pool):	1.5 ppm
Total Available CHL (Spa):	3.0 ppm
Free Available CHL (Spa):	3.0 ppm
pH:	7.4 - 7.6
Iron content:	0.0 ppm
Copper content:	0.0 ppm
Saturation Index	-.3- +.3
4. Stabilization (outdoor pool) 40 ppm

END OF SECTION 131550

SECTION 14 21 00 - ELECTRIC TRACTION ELEVATORS

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. This Section specifies an electric traction elevator.
 - 1. The work required under this section consists of labor, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevator as herein specified.
 - 2. In all cases where a device or part of the equipment is herein referred to in the singular, it is intended that such reference shall apply to as many of such devices or parts as are required to make complete installation.
- B. Related work not specified herein: The following sections contain requirements that relate to this section and are performed by trades other than the elevator manufacturer/installer.
 - 1. Division 1 Sections for protection of floor openings and personnel barriers; temporary power and lighting.
 - 2. Section 042000 - Unit Masonry: masonry hoistway enclosure, building-in and grouting hoistway doorframes, and grouting of sills.
 - 3. Section 055000 - Metal Fabrications: pit ladder, divider beams, and supports for entrances.
 - 4. Section 071700 - Bentonite Waterproofing: waterproofing of elevator pit.
 - 5. Division 26 Sections for:
 - a. Main disconnects for each elevator.
 - b. Electrical power for elevator installation and testing.
 - c. Disconnecting device to elevator equipment prior to activation of sprinkler system.
 - d. The installation of dedicated GFCI receptacles in the pit and overhead (with Machine room-less).
 - e. Lighting in controller area, machine area and pit.
 - f. Wiring for telephone service to controller.
 - g. Emergency (Standby) Power Supply Systems: emergency generator for elevator operation.
 - h. The installation of fire and smoke detectors at required locations and interconnecting devices; fire alarm signal lines to contacts in the machine room.

- C. Related work specified and issued with Structural Package: The following sections contain requirements that relate to this section and are performed by trades other than the elevator manufacturer/installer.
 - 1. Section 015000 - Construction Facilities and Temporary Controls: protection of floor openings and personnel barriers; temporary power and lighting.
 - 2. Section 312000 – Earth Moving: excavation for elevator pit.
 - 3. Section 033000 - Cast-In-Place Concrete: elevator pit, and elevator machine foundation.
 - 4. Division 7 Section “Bentonite Waterproofing” for waterproofing of elevator pit.
- D. Applicable Codes: Comply with applicable building codes and elevator codes at the project site, including but not limited to the following:
 - 1. ANSI A117.1, Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People.
 - 2. ADAAG, Americans with Disabilities Act Accessibility Guidelines.
 - 3. ANSI/NFPA 70, National Electrical Code.
 - 4. ANSI/NFPA 80, Fire Doors and Windows.
 - 5. ASME/ANSI A17.1, Safety Code for Elevators and Escalators.
 - 6. ANSI/UL 10B, Fire Tests of Door Assemblies.
 - 7. CAN/CSA C22.1, Canadian Electrical Code.
 - 8. CAN/CSA-B44, Safety Code for Elevators and Escalators.
 - 9. EN 12016 (May 1998): “EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity”
 - 10. Model & Local Building Codes.

1.3 SYSTEM DESCRIPTION

- A. Basis of Design: Schindler 3300 Gearless Traction Elevator as manufactured by Schindler Elevator.
- A. Equipment Control: Elevonic® Control System.
- B. Quantity of Elevators: Two (2), Elevator A and Elevator B.
- C. Elevator Stop Designations: Elevator A: Levels 1,2,3,4 , Elevator B: Levels 1,2,3,4.
- D. Stops: Elevator A: Four (4), Elevator B: Four (4).
- E. Front Openings: Elevator A: Front, Elevator B: Front
- F. Rear Openings: Elevator A: Rear, Elevator B: N/A
- G. Travel: Elevator A: 34’ – 8”., Elevator B: 34’-8”.
- H. Rated Capacity: Elevator A: 3300 lb., Elevator B: 3300 lb.
- I. Rated Speed: Elevator A: 150 fpm, Elevator B: 150 fpm.
- J. Platform Size: Elevator A: 7’ 9-1/2” W x 5’ 5-9/16” D. Elevator B: 6’ 9-1/2” W x 5’ 5-9/16” D.

- K. Clear Inside Dimensions: Elevator A: 6' 9-3/8" W x 4' 10-7/8" D., Elevator B: 6' 9-3/8" W x 4' 10-7/8" D.
- L. Cab Height: Elevator A: 7' 9", Elevator B: 7' 9".
- M. Entrance Type and Width: Elevator A: Single Speed Center Opening 3' 6" w x 7' 0" high doors, Elevator B: Single Speed Center Opening 3' 6" w x 7' 0" high doors.
- N. Entrance Height: Elevator A: 7' 0", Elevator B: 7' 0".
- O. Main Power Supply: 480 Volts + or - 5% of normal, three-Phase, with a separate equipment grounding conductor.
- P. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.
- Q. Machine Location: Inside the hoistway at the top.
- R. Signal Fixtures: Manufacturer's standard.
- S. Controller Location: Controller(s) shall be located adjacent to the hoistway at the top landing in a controller space.
- T. Performance:
 - 1. Car Capacity: Safely lower, stop and hold up to 125% of rated load. (code required).
- U. Ride Quality:
 - 1. Vertical Vibration (maximum): 12 – 17 milli-g
 - 2. Horizontal Vibration (maximum): 10 – 15 milli-g
 - 3. Vertical Jerk (maximum): $4.6 \pm 1.0 \text{ ft./ sec}^3$ ($1.4 \pm 0.3 \text{ m/ sec}^3$)
 - 4. Acceleration/Deceleration (maximum): $2.6 \pm .33 \text{ ft./ sec}^2$ ($0.8 \pm 0.13 \text{ m/ sec}^2$)
 - 5. In Car Noise: 50 – 55 dB(A)
 - 6. Stopping Accuracy: $\pm 0.2 \text{ in.}$ ($\pm 5 \text{ mm}$)
 - 7. Re-leveling Distance: $\pm 0.4 \text{ in.}$ ($\pm 10 \text{ mm}$)
- V. Operation: Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
- W. Operating Features – Standard Full Collective Operation
 - 1. Anti-nuisance.
 - 2. Fan and Light Protection.
 - 3. Load Weighing Bypass.
 - 4. Independent Service.
 - 5. Full Collective Operation.
 - 6. Firefighters' Service Phase I and Phase II.
 - 7. Top of Car Inspection.

- X. Automatic Standby Power Operation with Manual Override. This operation shall return each car automatically to a designated landing when the system is initially switched to standby power. One or more cars are returned at a time. Preference is given to loaded cars over empty cars in order to reduce passenger wait times. A car must respond by beginning to move toward the designated landing within a pre-determined time. If a car does not respond, it is automatically placed in a "Not Available" mode while other cars are moved. If a car was not returned to the designated landing on the first try, a second attempt is made. If the second attempt is not successful, the car will remain in a "Not Available" mode and can only be moved by manual means. Once each car has returned to the designated landing, the doors will remain open for a predetermined amount of time.

When all cars have successfully returned to the designated landing or have attempted to move twice, automatic selection of the car(s) to run on normal operation will occur.

If for any reason a car selected for normal operation under standby power is delayed for 60 seconds, the car will be placed in a "Not Available" mode and another car will be selected for normal operation based on the priorities listed above.

Manual Override of Standby Power Operation is achieved by a manual input for each car via a strip switch. A manually selected car may be run either in a return operation to a designated landing or in normal operation under standby power. If a manually selected car has not yet returned to the designated landing, it will perform this operation first then immediately go into normal operation.

If a manually selected car is delayed, no other car can be selected in the group unless it is manually selected.

If car selection is changed by Manual Override while a car is running in return or normal operation under standby power, the newly selected car will not be permitted to run until the car that had been running has stopped, opened its doors, and gone into the Standby Power Wait state.

- Y. Door Control Features:

Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.

1. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person. Primary door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening. Under normal operation and for any door position, the system shall detect as a blockage an opaque object that is equal to or greater than 1.3 inches (33 mm) in diameter when inserted between the car doors at vertical positions from within 1 inch (25 mm) above the sill to 71 inches (1800 mm) above the sill. Under degraded conditions (one or more blocked or failed beams), the primary protection shall detect opaque objects that are equal to or greater than 4" (100 mm) in diameter for the same vertical coverage. If the system performance is degraded to the point that the 4" object cannot be detected, the system shall maintain the doors open or permit closing only under nudging force conditions.

The secondary protection shall have an anti-nuisance feature that will ignore detection in the secondary zone after continual detection occurs for a significant time period in the secondary zone without corresponding detection in the primary protection zone; i.e. a person/object is in the entryway but does not enter. Normal secondary protection shall be re-enabled whenever detection occurs in the primary zone.

The reaction time of the door detector sub-system shall not exceed 60 milliseconds when both primary and secondary protection capabilities are active; nor 40 milliseconds when the secondary protection is disabled. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:
 - 1. Signal and operating fixtures, operating panels and indicators.
 - 2. Cab design, dimensions and layout.
 - 3. Hoistway-door and frame details.
 - 4. Electrical characteristics and connection requirements.
 - 5. Expected heat dissipation of elevator equipment in control room space and machine space (BTU).
 - 6. Color selection chart for Cab and Entrances.
- B. Shop Drawings: Submit approval layout drawings. Include the following:
 - 1. Car, guide rails, buffers and other components in hoistway.
 - 2. Maximum rail bracket spacing.
 - 3. Maximum loads imposed on guide rails requiring load transfer to building structure.
 - 4. Clearances and travel of car.
 - 5. Clear inside hoistway and pit dimensions.
 - 6. Location and sizes of access doors, hoistway entrances and frames.
- C. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Elevator manufacturer shall be ISO 9002 certified.
- B. Regulatory Requirements: In addition to local governing regulations, comply with applicable provisions in ASME A17.1, "Safety Code for Elevators and Escalators."
 - 1. Seismic Risk Zone: Project is located in Zone 0 or 1.
- C. Installer Qualifications: Elevator manufacturer or an experienced installer approved by elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

- D. Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permit as required by the elevator inspection authority, and make such tests as are called for by the regulations or such authorities. These tests shall be made in the presence of such authorities or their authorized representatives.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor will be responsible to provide a proper and suitable storage area on or off the premises.

Should the storage area be off-site and the equipment not yet delivered, then the elevator contractor, upon notification from the General Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the General Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage, and redeliver to the job site shall not be at the expense of the elevator contractor.

1.7 WARRANTY

- A. The elevator contractor's acceptance is conditional on the understanding that their warranty covers defective material and workmanship. The guarantee period shall not extend longer than one (1) year from the date of completion or acceptance thereof by beneficial use, whichever is earlier, of each elevator. The guarantee excludes: ordinary wear and tear or improper use, vandalism, abuse, misuse, or neglect or any other causes beyond the control of the elevator contractor and this express warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

1.8 MAINTENANCE AND SERVICE

- A. Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided by the elevator contractor for a period of twelve (12) months after the elevator has been turned over for the customer's use. This service shall not be subcontracted but shall be performed by the elevator contractor. All work shall be performed by competent employees during regular working hours of regular working days and shall include emergency 24-hour callback service. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.
- B. The elevator control system must:
1. Provide in the controller the necessary devices to run the elevator in inspection operation.
 2. Provide on top of the car the necessary devices to run the elevator in inspection operation.
 3. Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.

4. Provide in the event of a power outage, means from the controller to electrically lift and control the elevator brake to safely bring the elevator to the nearest available landing.
5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.

PART 2 - PRODUCTS

2.1 DESIGN AND SPECIFICATIONS

- A. Basis of Design: 3300 Machine room-less traction passenger elevator from Schindler Elevator Company or comparable product by:
1. Otis Elevator
 2. Thyssen Krupp

2.2 EQUIPMENT: CONTROL ROOM COMPONENTS

- A. Controller: A microcomputer based control system shall be provided to perform all of the functions of safe elevator operation. The system shall also perform car and group operational control.
1. All high voltage (110V or above) contact points inside the controller cabinet shall be protected from accidental contact in a situation where the controller doors are open.
 2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed so as to be physically segregated from the rest of the controller.
 3. Field conductor terminations points shall be segregated; high voltage (>30 volts DC and 110 VAC,) and low voltage (< 30 volts DC)
 4. Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity"
- B. Drive: A Variable Voltage Variable Frequency AC drive system shall be provided.

2.3 EQUIPMENT: MACHINE AND GOVERNOR

- A. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.
- B. Governor: The governor shall be a tension type governor.
- C. Buffers, Car and Counterweight: Compression spring type buffers shall be used.
- D. Hoistway Operating Devices:

1. Emergency stop switch in the pit
 2. Terminal stopping switches.
- E. Positioning System: Consists of an encoder, reader box, and door zone vanes.
- F. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.
- G. Coated Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords.
- H. Governor Rope: Governor rope shall be steel and shall consist of at least eight strands wound about a sisal core center.
- I. Fascia: Galvanized sheet steel shall be provided at the front of the hoistway.
- J. Hoistway Entrances:
1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
 2. Sills shall be extruded Aluminum.
 3. Doors: Entrance doors shall be of hollow metal construction with vertical internal channel reinforcements.
 4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour.
 5. Entrance Finish: Satin stainless steel.
 6. Entrance marking plates: Entrance jambs shall be marked with 4" x 4" (102 mm x 102 mm) plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
 7. Sight Guards: Black sight guards will be furnished with any metal finish door. Powder-coated matching sight guards will be furnished with powder-coated doors.

2.4 EQUIPMENT: CAR COMPONENTS

- A. Car frame and Safety: A car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral to the car frame and shall be Type "B", flexible guide clamp type.
- B. Plastic-Laminate Wall Panels: Vertical applied panels of plastic laminate adhesively applied to 3/4-inch fire-retardant-treated particleboard with plastic-laminate panel backing and manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 or less, when tested according to ASTM E 84.
- C. Car Front Finish: Satin stainless steel.
- D. Car Door Finish: Satin stainless steel.
- E. Ceiling Type:

1. Vinyl Egg Crate.
- F. Handrail: Rear wall only, Stainless Steel.
- G. Pad Hooks: Side and rear walls.
- H. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car and provide current to the alarm bell in the event of building power failure.
- I. Floor prepared to receive carpet. (specified in Division 9 Section). Temporary carpet by elevator manufacturer.
- J. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply
- K. Emergency Pulsating Siren: Siren mounted on top of the car that is activated when the Alarm button in the car operating panel is engaged. Siren shall have a rated sound pressure level of 80 dB(A) at a distance of 3.0 m from the device. Siren shall respond with a delay of not more than 1 second after the switch or push button has been pressed.
1. Fan: A two-speed 120 VAC fan will be mounted to the structural ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. This two-speed fan produces airflow rates of 5.8 and 7.4 m³/min on low and high setting respectively. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.
 2. Handrail: Flat Solid Metal 1/4" (6 mm) x 8" (203 mm) satin finish stainless steel provided on the sides and rear of the car enclosure.
- L. Threshold: Aluminum.
- M. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.
- N. Roller Guides: Rubber roller guides shall be mounted on the top and the bottom of the car and counterweight. Car roller guides shall be 3" (76mm) [Optional] <6-1/4" (160mm)> at the top of the car, and 6-1/4" (160mm) at the bottom. The counterweight roller guides shall be 3" (76mm) at the top and the bottom.
- O. Platform: The car platform shall be constructed of 2 layers of plywood and 2 layers of .032" (.81mm) thick aluminum laminate for a total thickness of 1-1/2" (38mm). Load weighing device shall be mounted under the platform.
- P. Certificate frame: Provide a Certificate frame with a satin stainless steel finish.

2.5 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

- A. Car Operating Panel: A car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a satin stainless steel finish.
 - 1. Applied car operating panel shall be furnished. It shall contain a bank of round metal mechanical illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served, an emergency call button, door open and door close buttons, and switches for lights, inspection and the exhaust fan. The emergency call button shall be connected to a bell that serves as an emergency signal. All buttons to have raised numerals and Braille markings. Red LED halo illumination with 1/8" projecting targets. Target finishes: Satin stainless steel.
- B. Car Position Indicator: A 16-segment, digital, vacuum fluorescent car position indicator shall be integral to the car operating panel.
- C. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation.
 - 1. Hall fixtures shall feature round mechanical buttons in flush mount face frame. Buttons shall be manufacturer's standard in vertically mounted fixture. Hall lanterns and position indicators shall be illuminated by means of LED. Fixture shall be satin stainless steel finish.
- D. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Installation of all elevator components except as specifically provided for elsewhere by others.

3.3 DEMONSTRATION

- A. The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

END OF SECTION 142100

SECTION 14 91 00 - FACILITY CHUTES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes laundry chutes.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For chutes. Include plans, elevations, sections, details, weights, operational clearances, and attachments to other work. Indicate method of field assembly.
 - 1. Wiring Diagrams: Power, signal and control wiring.
- C. Product certificates.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Fire-Rated Door Assemblies: 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.
 - 1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.
 - 2. Intake Door: Class B labeled; [2]-hour fire rated[with 30-minute temperature rise of 250 deg F (140 deg C)].
 - 3. Discharge Door: Class B labeled; 2-hour fire rated[with 30-minute temperature rise of 250 deg F (140 deg C)].
 - 4. Access Door: Class B labeled; [1] [1-1/2]-hour fire rated[with 30-minute temperature rise of 250 deg F (140 deg C)].
- 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. Standard: Provide chutes complying with NFPA 82.

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. American Chute Systems, Inc.
2. Chutes International.
3. Midland Chutes.
4. U.S. Chutes.
5. Valiant Products, Inc.
6. Western Chutes; Div. of Buchanan Company, Inc.
7. Wilkinson Hi-Rise, LLC.

2.2 CHUTES

- A. Chute Metal: [Aluminum-coated, cold-rolled, commercial steel sheet; ASTM A 463/A 463M, Type 1 with not less than **T1-40 (T1M-120)** coating] [Type 430 stainless steel, ASTM A 240/A 240M] [Type 304 stainless steel, ASTM A 240/A 240M].
1. Thickness: [**0.060 inch (1.6 mm)**] [**0.075 inch (1.9 mm)**].
- B. Size: [**24-inch (610-mm)** diameter]

2.3 DOORS

- A. Intake Door Assemblies: ASTM A 240/A 240M, Type 304 stainless-steel, self-closing units with positive latch and latch handle; as required to provide fire-protection[and temperature-rise] ratings indicated; and with frame suitable for enclosing chase construction.
1. Door Type: [Hopper]
 2. Size: Manufacturer's standard size for door type, chute type, and diameter indicated.
 3. Finish: Manufacturer's standard satin or No. 3 directional polish.
 4. Baffles: Rubber-back draft baffles at each intake.
 5. Electrical Interlocks: Interlock system that is energized by opening one intake door; remaining doors automatically lock when system is energized.
- B. Discharge-Door Assemblies: Aluminum-coated-steel doors as required to provide fire-protection[and temperature-rise] ratings indicated; equipped with fusible links that cause doors to close in the event of fire.
1. Direct Vertical Discharge: Provide inclined, horizontally rolling, shutter-type unit.
 2. Horizontal Discharge: Provide top-hinged, self-closing, hopper door with self-latching hardware; floor-mounted leg brace designed to absorb impact of material dropping against chute; and minimum **NPS 2 (DN 50)** drain pipe connection.
- C. Heat-[and Smoke-]Detector System: Interlock system with temperature-rise elements that locks chute doors when temperature in chute reaches a predetermined, adjustable temperature.
1. Locate smoke detector outside discharge door with solenoid to close discharge door.
- D. Access Door Assemblies: Manufacturer's standard ASTM A 240/A 240M, Type 302/304 stainless-steel doors; as required to provide fire-protection[and temperature-rise] ratings indicated; with frame suitable for enclosing chase construction; and in satin or No. 3 directional polish finish.

- E. Manual Control System: Control system with manual switches that lock doors of chute during shutdown hours and service operations.

2.4 ACCESSORIES

- A. Fire Sprinklers: Manufacturer's standard NPS 1/2 (DN 13) fire sprinklers ready for piping connections.
- B. Flushing Spray Unit: NPS 3/4 (DN 19) spray head unit located in chute above highest intake door, ready for hot-water piping connection, and with access for head and piping maintenance.
- C. Sanitizing Unit: NPS 3/4 (DN 19) disinfecting and sanitizing spray head unit located in chute above highest intake door, including 1-gal. (3.8-L) tank and adjustable proportioning valve with bypass for manual control of sanitizing and flushing operation, ready for hot-water piping connection, and with access for head and piping maintenance.
- D. Intake Door Baffles: Rubber baffles, 1/8 inch (3 mm) thick.
- E. Sound Dampening: Manufacturer's standard [sound deadening coating on exterior of chute]

2.5 FABRICATION

- A. General: Factory assemble chutes to greatest extent practical with continuously welded or lock-seamed joints without bolts, rivets, or clips projecting on chute interior. Include intake door assemblies and metal supporting framing at each floor, and chute expansion joints between each support point.
- B. Roof Vent: Fabricate vent unit to extend [36 inches above roof with full-diameter, screened vent and metal safety cap or glass explosion-release cap. Fabricate with roof-deck flange, counterflashing, and clamping ring of nonferrous metal compatible with chute metal.
- C. Fire Sprinklers: Comply with NFPA 13. Locate fire sprinklers at or above the top service opening of chutes, within the chute at alternate floor levels in buildings more than two stories tall, and at the lowest service level.
- D. Equipment Access: Fabricate chutes with access for maintaining equipment located within the chute, such as flushing and sanitizing units, fire sprinklers, and plumbing and electrical connections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with NFPA 82 requirements and with chute manufacturer's written instructions. Assemble components with tight, nonleaking joints. Anchor securely to supporting structure to withstand impact and stresses on vent units. Install chute and components to maintain fire-resistive construction of chute and enclosing chase.

- B. Install chutes plumb, without offsets or obstructions that might prevent materials from free falling within chutes.
- C. Anchor roof flanges of chute vents before installing roofing and flashing. Install chute-vent counterflashing after roofing and roof-penetration flashing are installed.
- D. Intake and Discharge Doors: Interface door units with throat sections of chutes for safe, snag-resistant, sanitary depositing of materials in chutes by users.
 - 1. Coordinate installation of foot-pedal door operator with installation of door and enclosing chase.
 - 2. Interconnect sanitizer control with door interlock system.
- E. Electrical Interlock System: Comply with applicable NECA 1 recommendations.
- F. Test chute components after installation. Operate doors, locks, and interlock systems to demonstrate that hardware is adjusted and electrical wiring is connected correctly. Complete test operations before installing chase enclosures.
- G. Test heat- [and smoke-]sensing devices for proper operation.
- H. Operate sanitizing unit through one complete cycle of chute use and cleanup, and replenish chemicals or cleaning fluids in unit containers.
- I. After completing chase enclosure, clean exposed surfaces of chute system's components. Do not remove labels of independent testing and inspecting agencies.

3.2 DEMONSTRATION

- A. Demonstrate use of chute and equipment to Owner's personnel.
- B. Demonstrate replenishment of sanitizing-unit chemicals or cleaning fluids.

END OF SECTION 149100



Project Manual

for

Hampton Inn & Suites

Bair Blvd, New Stanton, PA 15672

Owner: Stanton Hospitality, LLC

Volume II

Divisions 21 through 33

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SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Piping Materials and Fittings
 - 2. Joining Materials
 - 3. Dielectric Fittings
 - 4. Mechanical Sleeve Seals
 - 5. Piping Specialties
 - 6. Piping Installation
 - 7. Equipment Installation
 - 8. Erection of Metal Supports
 - 9. Cutting and Patching
 - 10. Grouting
- B. Related Sections:
 - 1. Section 21 10 00 – Fire Suppression Systems

1.02 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PVC: Polyvinyl chloride plastic.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.
2. Coordination Drawings: Detail major elements, components, and systems of fire suppression equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 - a. Planned piping layout, including valve and specialty locations and valve-stem movement.
 - b. Clearances for installing and maintaining installation.
 - c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - d. Equipment and accessory service connections and support details.
 - e. Exterior wall and foundation penetrations.
 - f. Fire-rated wall and floor penetrations.
 - g. Sizes and location of required concrete pads and bases.
 - h. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 - i. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - j. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- C. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- D. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.04 SEQUENCING AND SCHEDULING

- A. Coordinate fire suppression equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for fire suppression installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of fire suppression materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate requirements for access panels and doors if fire suppression items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Section 08 31 00 - "Access Doors and Panels."

- F. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.05 Posted Operating Instructions

- A. Provide and post operating instructions for all fire suppression systems.

PART 2 PRODUCTS

2.01 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solvent Cements: Manufacturer's standard solvent cements for the following:
 - 1. ABS Piping: ASTM D2235.
 - 2. CPVC Piping: ASTM F493.
 - 3. PVC Piping: ASTM D2564. Include primer according to ASTM F656.
 - 4. PVC to ABS Piping Transition: ASTM D3138.
- F. Plastic Pipe Seals: ASTM F477, elastomeric gasket.
- G. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- H. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
 - 1. Sleeve: ASTM A126, Class B, gray iron.
 - 2. Followers: ASTM A47 malleable iron or ASTM A536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.02 DIELECTRIC FITTINGS

- A. Approved Manufacturers:
 - 1. Anvil International, Inc.,
 - 2. Grinnell Mechanical Products,

3. Victaulic Co. of America

- B. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- C. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- D. Insulating Material: Suitable for system fluid, pressure, and temperature.
- E. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- F. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.
- G. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Provide separate companion flanges and steel bolts and nuts for 150-psig minimum working pressure as required to suit system pressures.
- H. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

2.03 MECHANICAL SLEEVE SEALS

- A. Approved Manufacturers:
 - a. Metraflex Inc.
 - b. PSI-Thunderline/Link-Seal
- B. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.04 PIPING SPECIALTIES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
 - 4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.
- B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
 - 1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 - 2. OD: Completely cover opening.
 - 3. Cast Brass: Split casting, with concealed hinge and set screw.
 - a. Finish: Polished chrome-plate.

4. Cast-Iron Floor Plate: One-piece casting.

2.05 GROUT

- A. Non-shrink, Nonmetallic Grout: ASTM C1107, Grade B.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psig, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specifies otherwise. Individual Division 21 piping Sections specifies unique piping installation requirements.
- B. General Locations and Arrangements: 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 as required by Division 01 Sections and as outlined in Part 1 of this section.
- C. Install piping at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
 - 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast brass with concealed hinge, set screws, and chrome-plated finish.
 - 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

- N. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping rings where required.
 - 2. Build sleeves into walls and slabs as work progresses.
 - 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).
 - b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS (DN150) and larger, penetrating gypsum-board partitions.
 - 4. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Refer to Section 07 62 00 "Sheet Metal Flashing and Trim" for flashing.
 - a. Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
 - 5. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealant. Refer to Section 07 92 00 "Joint Sealants" for materials.
 - 6. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- O. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
 - 3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stopping materials. Refer to Section 07 84 00 - "Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

- T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. 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:
 - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. 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.
 4. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 5. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
 6. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 - a. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. CPVC Piping: ASTM D2846 and ASTM F493.
 - c. PVC Pressure Piping: ASTM D2672.
 - d. PVC Non-pressure Piping: ASTM D2855.
 7. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657 procedures and manufacturer's written instructions.
 - a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
- U. Piping Connections: Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.

2. Install flanges, in piping 2-1/2-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.02 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights is not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Owner's Representative.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install fire suppression 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.
- E. Install equipment giving right of way to piping installed at required slope as specified in other Division 21 sections.
- F. Clearance from Electrical Equipment: Wet piping is prohibited in electric rooms and closets, elevator machine rooms and installation over transformers, switchboards and motor control centers.

3.03 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire suppression materials and equipment.
- B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."
- C. Prime and paint all metal supports per Section 09 90 00 requirements similar to "Pipes and Mechanical Equipment".

3.04 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for fire suppression installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.
- C. Refer to Division 01 Sections for additional requirements.

3.05 GROUTING

- A. Install nonmetallic, non-shrink, grout for fire suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.

- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

SECTION 21 10 00 - FIRE SUPPRESSION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pipe and Fittings.
2. Sprinklers.

B. Related Sections:

1. Section 21 05 00 – Common Work Results for Fire Suppression
2. Section 28 31 00 - Fire Alarm and Detection Systems: Wire and connection of sprinkler flow and tamper switches

1.02 SYSTEM DESCRIPTION

- A. The Fire Protection Subcontractor is responsible for code compliance, research, design, coordination, and installation of a complete and functional hydraulically calculated sprinkler system (and standpipe system, if required) that meets the approval of and is in accordance with all applicable regulations and requirements of the following and as further specified:
1. Current editions of NFPA 13, 14, 20, 25, and 96.
 2. Applicable Codes.
 3. Authorities having jurisdiction.
- B. Alarm system devices including alarm valves, flow switches, pressure switches, tamper switches and coordination with Fire Alarm and Detection Subcontractor.
- C. Shop drawings and calculations prepared and submitted in accordance with the requirements of all Authorities Having Jurisdiction.
- D. Obtaining all permits and approvals of the fire protection system.
- E. Field acceptance testing.

1.03 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 with the following supporting data:
1. Product Data:
 - a. Mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this project.
 - b. Submit separate "Letter of Conformance" for each specified item.
 2. Shop Drawings and calculations sealed by a registered Professional Engineer, NICET III or IV Sprinkler Designer, licensed in the state where the project is located.
 3. Be responsible for code research and obtaining all required flow test data and hydraulically designing a fire protection system that meets all applicable requirements. Arrange for, and conduct the flow test.
 4. Fire protection submittal data shall include the following:
 5. Flow Test Data.

6. Complete Hydraulic Calculations.
 7. Complete Stamped and Coordinated Shop Drawings.
 8. Pipe and Fittings.
 9. Valves.
 10. Sprinkler Heads.
 11. Escutcheons.
 12. All Applicable Devices, Alarms, and Specialties.
 13. Air Compressor and Accessories (If required)
 14. Applicable Control/Wiring Diagrams.
 15. Fire Department Connections
 16. Valve Cabinets
 17. Backflow Preventers.
- B. Submittal data shall be bound sets and be submitted at one time in accordance with Section 01 33 00 - Submittals and Substitutions.
- C. Be responsible for delays caused by not following the above procedure and/or not completing the design portion of the work in a timely manner.
- D. Record Documents:
1. Refer to Section 01 78 39 - Project Record Documents and Section 01 78 23 - Operating and Maintenance Data for required closeout documents to be provided at completion of Project. In addition to the documents listed in these Sections, the following documents shall be included:
 - a. Provide above/below ground test certificates.
 - b. Record Documents shall include System Drawings, Equipment Data and Operation Instructions, and Maintenance Instruction Manuals.

1.04 QUALITY ASSURANCE

- A. Refer to Section 21 05 00 – Common Work Results for Fire Suppression.
1. All sprinkler system equipment is to be UL Listed.

1.05 DESIGN

- A. Zoning: At a minimum, the system shall be zoned by floor or as required to meet the approval of all applicable Codes and Authorities, whichever is most stringent.
- B. Inspectors test connections: Locate at the remote end of each zone with discharge pipe to exterior.
- C. Low-Rise Buildings: Connect sprinkler piping to riser at each zone. Provide control valve, flow and tamper switches at each connection monitored on the fire alarm system. Locate inspector's test assembly at remote end of zone with discharge piped to exterior drain.
- D. Design densities (based on NFPA 13 requirements):
1. Guest Rooms: Wet pipe system with 0.10 gpm per square foot, all heads (up to a maximum of 5) in the largest most remote guestroom plus 100 gpm for hose.

2. Public Spaces, Offices, and Dining Room: Wet pipe system with 0.10 gpm per square foot over the most remote 1,500 square feet plus 100 gpm for hose.
3. Kitchen Areas: Wet pipe system with 0.15 gpm per square foot over the most remote 1,500 square feet area plus 100 gpm for hose.
4. Mechanical rooms, Laundry, Storage, and Service Areas: Wet pipe system with 0.13 gpm per square foot over 2,500 square feet plus 100 gpm for hose.
- E. The Fire Protection Subcontractor shall be responsible for reviewing the complete set of Contract Documents and coordinating his work with all other trades involved including building design loads.
- F. Sprinkler head locations shall be as shown on the Reflected Ceiling Plans. If the Contractor finds that additional sprinklers are required to meet Codes, the Contractor shall proceed with the additional heads at no additional cost to the Owner.
- G. The fire protection piping and head layout shall function in such a manner so as not to interfere with lighting fixtures, air distribution devices, equipment, piping, beams, and ductwork. The work under this section shall yield to all other trades.

1.06 SPRINKLER/STANDPIPE SYSTEM

- A. Provide the building with a complete, approved, operational sprinkler system in all areas.
- B. Provide wet-pipe sprinklers for habitable spaces such as guestrooms, guestroom corridors, and public areas.
- C. Design documents are for information only. The Sprinkler subcontractor shall be responsible for the actual layouts, routing of piping, and additional sprinkler heads to meet all requirements of the authority having jurisdiction.
- D. Be responsible for freeze protection as follows:
 1. Wet piping shall not be routed through unheated areas, such as attics, etc.
 2. For repairing and/or all costs incurred from damage caused by freezing of the fire protection system.
 3. Use of Heat-tape is not acceptable.
 4. The dry pipe system is required to deliver water to the system test connection within 60 seconds, starting at the normal air pressure on the system and at the time of fully opened inspection test connection.
- E. Provide a Fire Department standpipe system where required by code.
- F. Provide a combination sprinkler/standpipe riser system where standpipes are required by code.
- G. The sprinkler layout for the guest rooms, suites, and corridors shall be as required to meet the approval of all applicable Codes, and Local Authorities whichever is most stringent.
- H. Guest Room Bathrooms: Sprinklers not required if less than 55 square feet unless combustible (with flame spread rating of greater than 25; i.e., fiberglass or plastic) tubs or shower enclosures are used.
- I. Pressure Reducing Valves: Design system within maximum pressure of 175 psi without use of pressure reducing valves.
- J. Safety Factor: Provide a 10% hydraulic safety factor up to a maximum of 10 psi.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. All sprinkler system equipment is to be UL Listed.

2.02 PIPE AND FITTINGS

- A. Piping - Class I, Schedule 40 ASTM black steel piping for branches and Class I Schedule 10 ASTM black steel for mains..
1. Piping (piping only, excluding fittings) for dry systems shall be galvanized steel.
 2. Alternate: CPVC or XL Thin-wall for wet sprinkler pipe.
- B. Exposed piping and fittings in kitchen shall be chrome-plated.

2.03 SPRINKLERS

- A. Sprinkler heads shall be UL Listed.
- B. Sprinkler heads and escutcheons shall have a white finish unless noted otherwise.
- C. Sprinklers: Fast-response 68 degrees C – 74 degrees C (155 degrees F – 165 degrees F), recessed or semi-recessed type heads throughout, except as follows:
- Mechanical/Electrical Rooms; Quick Response (155-165°F)
 - Elevator Machinery; Quick Response (212°F)
 - Swimming Pools; Corrosion proof/Quick Response (165-170°F)

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and support fire protection system to resist all applicable seismic forces per requirements.
- B. Locate wet pipe inspector test valves and associated sight glasses at remote ends of system, in accessible locations. Provide drain pipes to exterior. Do not discharge onto sidewalks or landscaping.
- C. Under no circumstance shall wet sprinkler pipes be routed through attics or other unheated spaces.
- D. Access panels for service and access to valves in enclosed ceiling and walls.

3.02 TESTING

- A. Before a property is opened to the public, the fire protection system shall be fully operational, contractor tested, and approved. In order to obtain approval, the fire protection system shall be operated by the contractor under simulated emergency conditions in the presence of an inspector and the contractor shall demonstrate compliance with the hotels standards.
- B. Automatic Sprinkler System:
1. Contractor shall flush and pressure test system prior to the inspector's observation of the test of water flow and tamper switches.
- C. Provide all equipment necessary to perform test.
- D. Refer to Submittals Paragraph for required certifications and documents to be provided with closeout documents.

3.03 TRAINING

- A. Conduct training as specified in Section 01 79 00 - "Training".
- B. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining system.
- C. Schedule training with Owner with at least seven days' advance notice.

END OF SECTION

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Piping materials and fittings.
2. Joining materials.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Piping Specialties
6. Grouting
7. Piping Insulation.
8. Equipment Installation.
9. Concrete Bases.
10. Erection of Metal Supports.
11. Cutting and Patching

B. Related Sections:

1. Section 01 31 00 – Project Management and Coordination
2. Section 01 73 29 - Cutting and Patching
3. Section 01 78 43 - Spare Parts and Materials
4. Section 01 79 00 - Training
5. Section 01 78 23 - Operating and Maintenance Data
6. Section 03 30 00 - Cast-in-Place Concrete
7. Section 06 10 00 - Rough Carpentry
8. Section 07 62 00 - Sheet Metal Flashing and Trim
9. Section 07 84 00 - Firestopping
10. Section 08 31 00 - Access Doors
11. Section 09 90 00 - Painting
12. Section 22 05 53 – Identification for Plumbing Piping and Equipment: Labeling and identifying plumbing systems and equipment.
13. Section 31 20 00 – Earth Moving

1.02 REFERENCES

A. The American Society of Mechanical Engineers (ASME) Publications:

1. B1.20.1 "Pipe Threads, General Purpose, Inch"
2. B16.21 "Nonmetallic Flat Gaskets for Pipes Flanges"
3. B18.2.1 "Square and Hex Bolts and Screws, Inch Series"

- B. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
1. A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"
 2. A536 "Standard Specification for Ductile Iron Castings"
 3. B32 "Standard Specification for Solder Metal"
 4. C1107 "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)"
 5. D2235 "Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings"
 6. D2657 "Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings"
 7. D2672 "Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement"
 8. D2846 "Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems"
 9. D2855 "Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings"
 10. D3138 "Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components"
 11. F402 "Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings"
 12. F477 "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe"
 13. F493 "Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings"
 14. F656 "Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings"
- C. American Welding Society (AWS) Publications:
1. BRH "Brazing Handbook"
 2. A5.8 "Specification for Filler Metals For Brazing And Braze Welding"
 3. D1.1 "Structural Welding Code - Steel"
 4. D10.12 "Guide for Welding Mild Steel Pipe"
- D. American Water Works Association (AWWA) Publications:
1. C110/ANSI A21.10 "Standard for Ductile-Iron and Gray-Iron Fittings, 3 In.-48 In. (76 mm-1,219 mm), for Water "
 2. C111/ANSI A21.11 "Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings"
- E. Copper Development Association (CDA) Publications:
1. "Copper Tube Handbook"

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data: For dielectric fittings, flexible connectors, plumbing sleeve seals, and identification materials and devices.
 - 2. Coordination Drawings: Detail major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 - a. Planned piping layout, including valve and specialty locations and valve-stem movement.
 - b. Clearances for installing and maintaining insulation.
 - c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - d. Equipment and accessory service connections and support details.
 - e. Exterior wall and foundation penetrations.
 - f. Fire-rated wall and floor penetrations.
 - g. Sizes and location of required concrete pads and bases.
 - h. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 - i. Floor plans, elevations, and details to indicate penetrations in floors, walls, and

1.05 QUALITY ASSURANCE

- A. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting plumbing and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases.
 - 1. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design requirements. See drawings for equipment schedules and requirements.

1.06 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 prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 SEQUENCING AND SCHEDULING

- A. Coordinate plumbing equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for plumbing installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if plumbing items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Section 08 31 13 - "Access Doors and Frames."
- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.08 Posted Operating Instructions

- A. Provide and post operating instructions for all plumbing systems.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Dielectric Unions:
 - a. Hart Industries, International, Inc.

- b. Watts Water Technologies, Inc.
 - c. Zurn Plumbing Products Group of Jacuzzi Brands, Inc.
- 2. Dielectric Flanges:
 - a. Capitol Manufacturing Company,
 - b. Central Plastics Co.
 - c. Watts Water Technologies, Inc.
- 3. Dielectric-Flange Insulating Kits:
 - a. Central Plastics Co.
- 4. Dielectric Couplings:
 - a. Lochinvar Corp.
- 5. Dielectric Nipples:
 - a. Grinnell Mechanical Products,
 - b. Perfection Corporation
 - c. Victaulic Co. of America
- 6. Plumbing Sleeve Seals:
 - a. Metraflex Inc.
 - b. PSI-Thunderline/Link-Seal

2.02 PIPE AND PIPE FITTINGS

- A. Refer to individual Divisions 22 piping Sections for pipe and fitting materials and joining methods.
 - 1. Section 22 11 16 - Domestic Water Piping.
 - 2. Section 22 13 16 – Sanitary Waste and Vent Piping.
 - 3. Section 23 11 23 – Facility Natural Gas Piping.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B32.
 - 1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
 - 2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.
 - 3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.
 - 4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.
 - 5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.
- F. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
 - 3. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements: Manufacturer's standard solvent cements for the following:
 - 1. ABS Piping: ASTM D2235.
 - 2. CPVC Piping: ASTM F493.
 - 3. PVC Piping: ASTM D2564. Include primer according to ASTM F656.
 - 4. PVC to ABS Piping Transition: ASTM D3138.
- H. Plastic Pipe Seals: ASTM F477, elastomeric gasket.
- I. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts and nuts.
- J. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
 - 1. Sleeve: ASTM A126, Class B, gray iron.
 - 2. Followers: ASTM A47 malleable iron or ASTM A536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.04 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
 - 1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
 - 2. Insulating Material: Suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

- C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.
- D. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Provide separate companion flanges and steel bolts and nuts for 150-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

2.05 Plumbing Sleeves

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
 - 4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.

2.06 PLUMBING SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.07 PIPING SPECIALTIES

- A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
 - 1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 - 2. OD: Completely cover opening.
 - 3. Cast Brass: Split casting, with concealed hinge and set screw.
 - a. Finish: Polished chrome-plate.
 - 4. Cast-Iron Floor Plate: One-piece casting.
- B. Grout:
 - 1. Non-shrink, Nonmetallic Grout: ASTM C1107, Grade B.
 - a. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
 - b. Design Mix: 5000-psig, 28-day compressive strength.
 - c. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install piping as described below, unless piping Sections specifies otherwise. Individual Division 22 piping Sections specifies unique piping installation requirements.
- B. General Locations and Arrangements: 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 as required by Division 01 Sections and as outlined in Part 1 of this section.
- C. Install piping at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
 - 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast brass with concealed hinge, set screws, and chrome-plated finish.
 - 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
- N. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of plumbing equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping rings where required.
 - 2. Build sleeves into walls and slabs as work progresses.
 - 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

- a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).
 - b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS (DN150) and larger, penetrating gypsum-board partitions.
4. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Section 07 62 00 "Sheet Metal Flashing and Trim" for flashing.
 - a. Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
5. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealant. Refer to Section 07 92 00 "Joint Sealants" for materials.
6. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- O. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and plumbing sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing plumbing sleeve seals.
 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
 3. Assemble and install plumbing sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using plumbing sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing plumbing sleeve seals.
 1. Assemble and install plumbing sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stopping materials. Refer to Section 07 84 00 - "Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to CDA's "Copper Tube Handbook."
 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

5. 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:
 - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. 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.
6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 - a. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. CPVC Piping: ASTM D2846 and ASTM F493.
 - c. PVC Pressure Piping: ASTM D2672.
 - d. PVC Non-pressure Piping: ASTM D2855.
9. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657 procedures and manufacturer's written instructions.
 - a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
- U. Piping Connections: Make connections according to the following, unless otherwise indicated:
 1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.
 2. Install flanges, in piping 2-1/2-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.02 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights is not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Owner's Representative.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. 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.
- E. Install equipment giving right of way to piping installed at required slope as specified in other Division 22 sections.
- F. Clearance from Electrical Equipment: Piping is prohibited in electric rooms and closets, elevator machine rooms and installation over transformers, switchboards and motor control centers.

3.03 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi 28-day compressive-strength concrete and reinforcement as specified in Section 03 30 00 - "Cast-in-Place Concrete."

3.04 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- 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, "Structural Welding Code--Steel."
- C. Prime and paint all metal supports per Section 09 90 00 requirements.

3.05 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for plumbing installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.
- C. Refer to Division 01 Sections for additional requirements.

3.06 GROUTING

- A. Install nonmetallic, non-shrink, grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.

- H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Basic Motor Requirements
 - 2. Polyphase Motors
 - 3. Single Phase Motors
- B. Related Sections:
 - 1. Division 22 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.02 REFERENCES

- A. Institute of Electrical and Electronics Engineers (IEEE) Publications:
 - 1. 112 "Standard Test Procedure for Polyphase Induction Motors and Generators"
- B. National Electrical Manufacturer's Association (NEMA) Standards Publications:
 - 1. MG 1 "Motors and Generators"
- C. National Fire Protection Association (NFPA) Publications:
 - 1. 70 "National Electric Code"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 - 1. Product Data: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Listing and Labeling: Provide motors specified in this Section that are listed and labeled.
 - 1. Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.

PART 2 PRODUCTS

2.01 BASIC MOTOR REQUIREMENTS

- A. Basic requirements apply to mechanical equipment motors, unless otherwise indicated.
- B. Motors 1/2 HP and Larger: Polyphase.
- C. Motors smaller than 1/2 HP: Single phase.
- D. Frequency Rating: 60 Hz.
- E. Voltage Rating: Determined by voltage of circuit to which motor is connected.
- F. Service Factor: According to NEMA MG 1, general purpose continuous duty, design type "B."

- G. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- H. Enclosure: Open drip proof, unless otherwise indicated.
- I. Efficiency: Motors shall have a higher efficiency rating than industry standard average motor as delineated in IEEE Standard 112, Test Method 13.

2.02 POLYPHASE MOTORS

- A. Description: NEMA MG 1, medium induction motor.
 - 1. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated.
 - 2. Energy-Efficient Design: Where indicated.
 - 3. Stator: Copper windings, unless otherwise indicated. Multispeed motors have separate winding for each speed.
 - 4. Rotor: Squirrel cage, unless otherwise indicated.
 - 5. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
 - 6. Temperature Rise: Match insulation rating, unless otherwise indicated.
 - 7. Insulation: Class F, unless otherwise indicated.
- B. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for indicated controller, with required motor leads brought to motor terminal box to suit control method.
- C. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Critical vibration frequencies are not within operating range of controller output.
 - 2. Temperature Rise: Match rating for Class B insulation.
 - 3. Insulation: Class H.
 - 4. Thermal Protection: Where indicated, conform to NEMA MG 1 requirements for thermally protected motors.
- D. Source Quality Control: Perform the following routine tests according to NEMA MG 1:
 - 1. Measurement of winding resistance.
 - 2. No-load readings of current and speed at rated voltage and frequency.
 - 3. Locked rotor current at rated frequency.
 - 4. High-potential test.
 - 5. Alignment.

2.03 SINGLE-PHASE MOTORS

- A. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.
 - 1. Permanent-split capacitor.

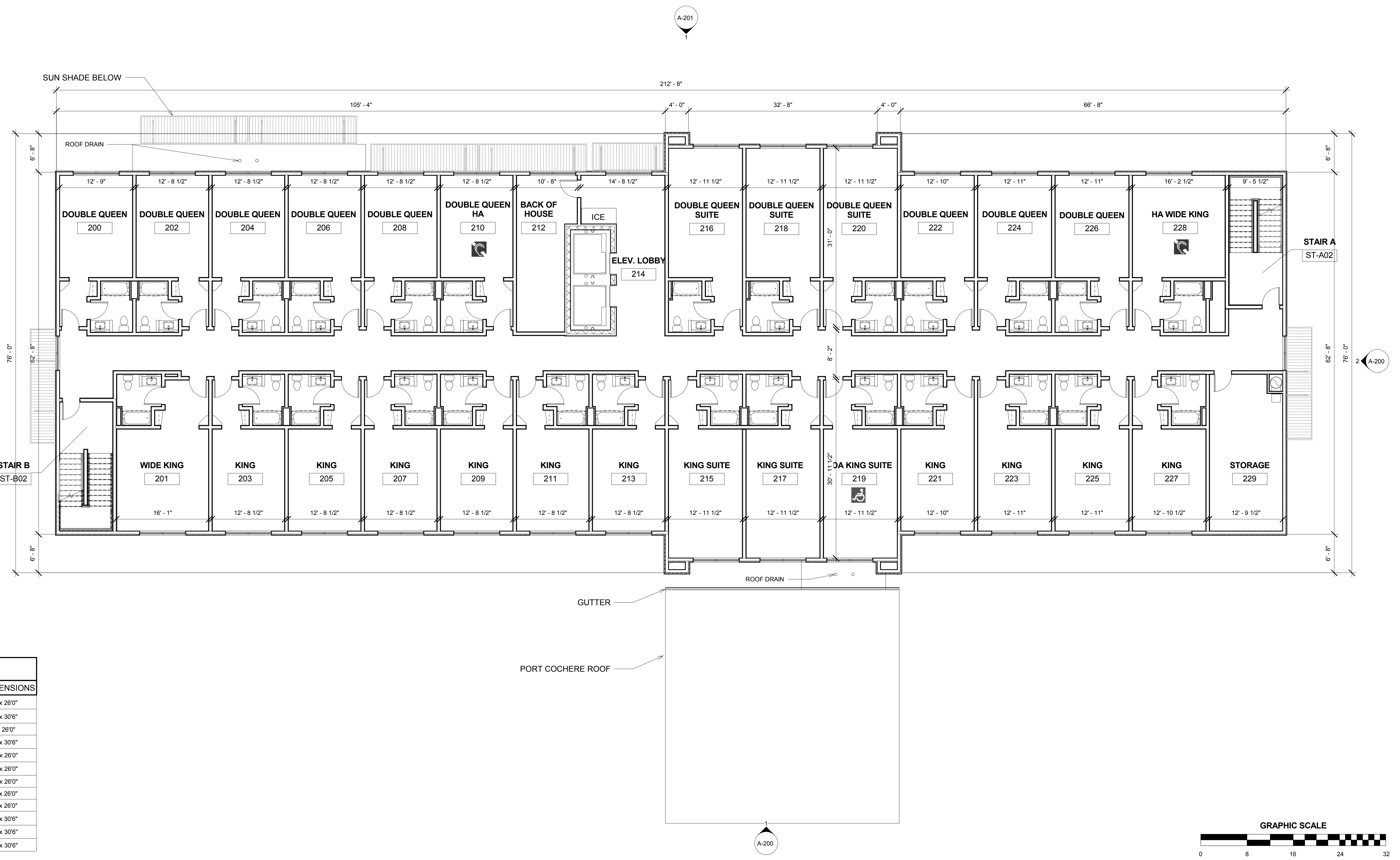
2. Split-phase start, capacitor run.
 3. Capacitor start, capacitor run.
- B. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 hp.
- C. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.
- D. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, pre-lubricated sleeve bearings for other single-phase motors.

PART 3 EXECUTION

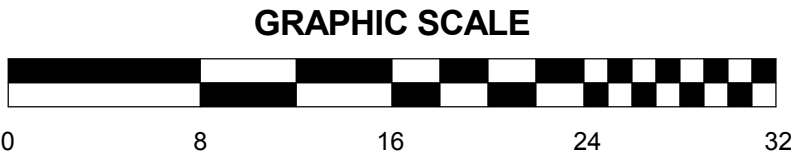
3.01 ADJUSTING

- A. Use adjustable motor mounting bases for belt-driven motors.
- B. Align pulleys and install belts.
- C. Tension according to manufacturer's written instructions.

END OF SECTION



MENTOR HOTEL ROOM STUDY		
ROOM TYPES PER FLOOR		DIMENSIONS
DOUBLE QUEEN	8	12'6" x 26'0"
DOUBLE QUEEN SUITE	3	12'6" x 30'6"
HA DOUBLE QUEEN	1	12'6" x 26'0"
ADA DOUBLE QUEEN	0	12'6" x 30'6"
KING	10	12'6" x 26'0"
HA KING	0	12'6" x 26'0"
WIDE KING	1	16'0" x 26'0"
ADA WIDE KING	0	16'0" x 26'0"
HA WIDE KING	1	16'0" x 26'0"
KING SUITE	2	12'6" x 30'6"
ADA KING SUITE	1	12'6" x 30'6"
HA KING SUITE	0	12'6" x 30'6"
TOTAL	27	



SECTION 22 05 19 - METERS AND GAUGES FOR PLUMBING PIPING

1.01 SUMMARY

A. Section Includes:

1. Thermometers.
2. Pressure Gages.
3. Water Meters.

B. Related Sections:

1. Section 22 11 23 - Natural Gas Piping: For gas meters.
2. Division 22 - Plumbing Equipment Sections that specify meters and gages as part of factory-fabricated equipment.
3. Section 32 84 00 - Irrigation Systems: For irrigation water sub-meters outside the buildings.
4. Section 33 00 00 - Utilities: For water meters outside the building.

1.02 REFERENCES

A. The American Society of Mechanical Engineers (ASME) Publications:

1. B40.100 "Pressure Gauges and Gauge Attachments"
2. B40.5 "Snubbers"

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

1. E1-03a "Standard Specification for ASTM Thermometers"

C. American Water Works Association (AWWA) Publications:

1. C700-02 AWWA Standard for Cold-Water Meters -- Displacement Type, Bronze Main Case
2. C701-02 Standard for Cold-Water Meters -- Turbine Type, for Customer Service
3. M6 "Water Meters: Selection, Installation, Testing, and Maintenance (M6)"

D. Underwriter's Laboratories, Inc. (UL) Standards:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors"
2. 486B "Standard for Wire Connectors for Use With Aluminum Conductors"

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data: Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty and accessory specified.

- a. Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.
2. Shop Drawings: Include schedule indicating manufacturer's number, scale range, fittings, and location for each meter and gage.
3. Product Certificates: Signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.
4. Maintenance Data: For meters and gages to include in maintenance manuals specified in Division 01. Include data for the following:
 - a. Flow-measuring systems.
 - b. Flow meters.
 - c. Water meters.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers:

1. Liquid-in-Glass Thermometers:
 - a. Ashcroft, Inc.
 - b. Marsh Bellofram
 - c. Weiss Instruments, Inc.
2. Pressure Gages:
 - a. Ashcroft, Inc.
 - b. Marsh Bellofram
 - c. Weiss Instruments, Inc.
3. Water Meters and Submeters:
 - a. As required by the local authority having jurisdiction.

2.02 THERMOMETERS, GENERAL

- A. Scale Range: Temperature ranges for services listed are as follows:
 1. Domestic Hot and Cold Water: 30 to 240 deg F, with 2-degree scale divisions.
- B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

2.03 THERMOMETERS - LIQUID-IN-GLASS

- A. Description: ASTM E1-03a.
- B. Case: Die cast and aluminum finished in baked-epoxy enamel, glass front, spring secured, 9 inches long.
- C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- D. Tube: Red or blue reading, mercury filled with magnifying lens.
- E. Scale: Satin-faced nonreflective aluminum with permanently etched markings.

- F. Stem: Brass for separable socket; of length to suit installation.

2.04 PRESSURE GAGES

- A. Description: ASME B40.100, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.
- B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch- diameter, glass lens.
- C. Connector: Brass, NPS 1/4 (DN8).
- D. Scale: White-coated aluminum with permanently etched markings.
- E. Accuracy: Grade A, plus or minus 1 percent of middle 50 percent of scale.
- F. Range: Comply with the following:
 - 1. Fluids under Pressure: Two times the operating pressure (or 0 to 160 psi).

2.05 PRESSURE-GAGE FITTINGS

- A. Valves: NPS 1/4 (DN8) brass needle type with round knurled handle.
- B. Snubbers: ASME B40.5, NPS 1/4 (DN8) extended stem brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

2.06 WATER METERS AND SUB-METERS

- A. Water Meter shall be provided as required by the local authority having jurisdiction.
- B. Provide and install sub-meter for site irrigation system.
- C. Description: AWWA C700-02, displacement type, bronze case. Registers flow in gallons (liters) or cubic feet (cubic meters) as required by utility.
- D. Description: AWWA C701-02, turbine type. Registers flow in gallons (liters) or cubic feet (cubic meters) as required.

PART 3 EXECUTION

3.01 INSTALLATION - METER AND GAGE, GENERAL

- A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.

3.02 INSTALLATION - THERMOMETER

- A. Install thermometers and adjust vertical and tilted positions.
- B. Install in the following locations:
 - 1. Domestic hot water supply main (downstream of storage tank).
 - 2. Domestic hot water return main & Domestic hot water storage tank.
 - 3. Domestic water heater discharge.
 - 4. Building domestic cold water service entrance.

3.03 INSTALLATION - PRESSURE-GAGE

- A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.
- B. Install dry-type pressure gages in the following locations:

1. Upstream and downstream of each pressure-reducing valve.
2. Building water-service entrance.
- C. Install liquid-filled-type pressure gages at suction and discharge of each pump.
- D. Install pressure-gage needle valve and snubber in piping to pressure gages.

3.04 INSTALLATION - WATER METER

- A. Install water meters, piping, and specialties according to AWWA M6 and utility's requirements.
 1. Install displacement-type water meters with shutoff valve on water meter inlet. Install valve on water meter outlet and valved bypass around meter, unless prohibited by authorities having jurisdiction.
 2. Install compound-type water meters with shutoff valves on water meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
 3. Install detector-type water meters with shutoff valves on water meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.
- B. Rough-In
 1. Install roughing-in piping and specialties for domestic water and/or site irrigation water meter installation according to utility's instructions and requirements.

3.05 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
 1. Install meters and gages adjacent to equipment to allow service and maintenance.
- B. Make electrical connections to power supply and electrically operated meters and devices.
- C. Ground electrically operated meters.
 1. 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 and UL 486B.
- D. Install electrical connections for power and devices.
- E. Electrical power, wiring, and connections are specified in Division 26 Sections.

3.06 ADJUSTING AND CLEANING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.
- C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION

SECTION 22 05 23 - GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Valves.

B. Related Sections:

1. Section 22 05 53 – Identification for Plumbing Piping and Equipment: For valve tags and charts.
2. Division 22 Plumbing Piping System Sections: Special purpose valves

1.02 REFERENCES

A. The American Society of Mechanical Engineers (ASME) Publications:

1. B1.20.1 "Pipe Threads, General Purpose, Inch"
2. B16.1 "Cast Iron Pipe Flanges and Flanged Fittings"
3. B16.5 "Pipe Flanges and Flanged Fittings"
4. B16.18 "Cast Copper Alloy Solder Joint Pressure Fittings"
5. B16.22 "Wrought Copper and Copper Alloy Solder Joint Pressure Fittings"
6. B16.24 "Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500 and 2500"
7. B31.1 "Power Piping"
8. B31.9 "Building Services Piping"

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

1. A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"
2. A126 "Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings"
3. A395 "Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures"
4. B62 "Standard Specification for Composition Bronze or Ounce Metal Castings"
5. B209 "Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate"
6. B283 "Standard Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)"
7. B584 "Standard Specification for Copper Alloy Sand Castings for General Applications"

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and

arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.

2. Maintenance data for valves to include in the operation and maintenance manual specified in Division 01. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.04 QUALITY ASSURANCE

- A. Single-Source Responsibility: Comply with the requirements specified in Division 01. Provide all valves of the same manufacturer where possible.
 1. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- B. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.
 3. Set globe and gate valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 1. Maintain valve end protection.
 2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 1. Ball Valves and Gate Valves:
 - a. Hammond Valve Corporation
 - b. Milwaukee Valve Company, Inc.
 - c. NIBCO Inc.
 2. Balancing Valves:
 - a. Victaulic Company
 - b. Hays Fluid Controls
 3. Check Valves:
 - a. Hammond Valve Corporation

- b. Milwaukee Valve Company, Inc.
- c. NIBCO Inc.
- 4. Blending Valves:
 - a. Cla-Val
- 5. Digital Recirculating Valve:
 - a. Armstrong International

2.02 GENERAL

- A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.
 - 1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.
- B. Sizes: Same size as upstream pipe, unless otherwise indicated.
- C. Operators: Use specified operators and handwheels, except provide the following special operator features:
 - 1. Handwheels: For valves other than quarter turn.
 - 2. Lever Handles: For quarter-turn valves 6 inches (DN150) and smaller, except for plug valves, which shall have square heads. Furnish Owner with 1 wrench for every 10 plug valves.
- D. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- E. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
- F. Threads: ASME B1.20.1.
- G. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
- H. Solder Joint: ASME B16.18.
 - 1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.03 BALL VALVES

- A. Ball Valves, 4 Inches (DN100) and Smaller: MSS SP-110, Class 150, 600-psi CWP, ASTM B584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch (DN15) valves and smaller and conventional port for 3/4-inch (DN20) valves and larger; blowout proof; bronze or brass stem; Teflon seats and seals; threaded or soldered end connections:
 - 1. Operator: Vinyl-covered steel lever handle.
 - 2. Stem Extension: For valves installed in insulated piping.
 - 3. Memory Stop: For operator handles (balancing valves).

2.04 GATE VALVES

- A. Gate Valves, 2-1/2 Inches (DN65) and Smaller: MSS SP-80; Class 125, 200-psi cold working pressure (CWP), ASTM B62 cast-bronze body and bonnet, solid-bronze wedge, copper-silicon alloy rising stem, Teflon-impregnated packing with bronze packing nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.
- B. Gate Valves, 3 Inches (DN80) and Larger: MSS SP-70, Class 125, 200-psi CWP, ASTM A126 cast-iron body and bonnet, solid cast-iron wedge, brass-alloy stem, outside screw and yoke, Teflon-impregnated packing with 2-piece packing gland assembly, flanged end connections; and with cast-iron handwheel.

2.05 BALANCING VALVES

- A. Calibrated Balancing Valves: Adjustable, with 2 readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
 - 1. 2-inch NPS (DN50) and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
- B. Memory-Stop Balancing Valves, 2-Inch NPS (DN50) and Smaller: MSS SP-110, ball valve, rated for 400-psig minimum CWP. Include 2-piece, ASTM B62 bronze body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, solder-joint ends, and vinyl-covered steel handle with memory-stop device.
- C. Automatic Flow Control Valves (AFCV): Automatic flow control valves shall be factory set to rated flow, and shall automatically control the flow to within 10% of the rated value, over a 40 to 1 differential pressure, operating range, (2 to 80 PSID). Operational temperature shall be rated from fluid freezing, to 225 degree F.
 - 1. "MESURFLO" by Hays Fluid Controls, or approved substitution by listed manufacturers.
 - a. Automatic Flow Control valve body shall be constructed of hot forged brass UNS C37700 or C36000 per ASTM B283 latest revision, ductile iron per ASTM A395, valve grade cast iron per ASTM B209, or UNS C84400 Cast Semi-Red Brass with inch size pipe thread fittings per ASME B1.20.1, and B31.9. UNS C37700 and UNS C36000 valve bodies are suitable for 600 PSIG Iron, and Cast Brass valve bodies are suitable for 400 PSIG. Working Pressure rating per ASTM A53 threaded joint type. Valve body shall also be available with sweat fittings per ASME B16.22 requirements and are intended for use in Building Services Piping meeting the requirements of ASME B31.9. The Temperature/Pressure Rating of the Solder Joint is dependent upon the type of solder used. ASME Standard B16.22 Pressure Ratings should be reviewed prior to sweating.
 - 2. "Y-BALL MESURFLO" by Hays Fluid Controls, or approved substitution by listed manufacturers:
 - a. Ball Valve, combination Automatic Flow Control Valves, shall be made of hot forged brass UNS C37700 per ASTM B283 Latest Revision, using full flow design balls, blowout proof stems, and shall be rated for 600 PSIG WOG.
 - b. Copper Sweat fittings 1/2, 3/4, 1 & 1 1/4, INCH shall be suitable for 522 PSIG. Working Pressure Rating per ASME B31.9 Building Services Piping.
 - c. Threaded fittings 1/2, through 1 1/2 INCH shall be suitable for 600 PSIG. Working Pressure Rating per ASTM A53B for threaded joint type extra weight, of the pipe size indicated. (For most Building Services applications, ANSI Class 125 rating.)

Flow rates from .5 to 24.0 GPM will have a differential pressure operating range of 2 to 80 PSID. Flow rates shall be field changeable without breaking the piping connections.

3. Valve internal control mechanism shall be of a quiet, clog resistant design and consist of one or more, precision sculptured brass or polyphenylsulfone with high temperature elastomeric diaphragm. Each automatic balancing valve will automatically control the flow rate within 10% of its rated flow, over a temperature range of 32 to 225 degree F, and a pressure differential range of 2-80 PSID. Flow increments shall be available in 0.125 to 0.5 GPM steps for 0.5 to 8.0 GPM, 1.0 to 2.0 GPM steps for 9.0 to 24 GPM, and 5.0 GPM steps for 25 to 200 GPM.
4. Dual pressure/temperature test ports for verifying the pressure differential and system temperature shall be standard.
5. Manufacturer shall provide certified independent laboratory tests verifying accuracy of performance.
6. All valves shall be marked per MMS-SP-25-78 (1983) and shall show as a minimum; controlled flow direction, flow rate, PSID control range, manufacturer and model number.

2.06 CHECK VALVES

- A. Swing Check Valves, 2-1/2 Inches (DN65) and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:
- B. Swing Check Valves, 3 Inches (DN80) and Larger: MSS SP-71, Class 125, 200-CWP, ASTM A126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.

2.07 DIGITAL RECIRCULATING VALVE (DRV)

- A. Re-circulating Valve shall be digital and of lead free stainless steel/polymer construction.
- B. DRV shall have all of the following operational capabilities:
 1. +/- 2F degree water temperature control.
 2. 2F degree minimum inlet to outlet water temperature differential
 3. Automatic shutoff of hot water flow upon cold water inlet supply failure.
 4. Automatic shutoff of hot water flow in the event of a power failure.
 5. Programmable set point range of 81-158°F (27-70°C)
 6. Programmable thermal disinfection mode.
 7. Programmable 1st level hi/lo temp alarm display.
 8. Programmable temperature error level for safety shutdown.
- C. DRV shall have all of the following connectivity capabilities:
 1. SPCO relay outputs which are energized during operation.
 2. LCD display which indicates: Set point, delivered temperature, error codes and alarm conditions.

- 3. MODBUS 485 port for remote set point adjustment and remote operating temperature visibility.
- 4. RS485 Serial Port for connection to a performance matched hot water monitoring system.
- D. DRV shall be compliant with ASME Standard 1017 and CSA B125.3 and so certified and identified.
- E. DRV shall be UL listed and identified.

2.08 BLENDING VALVE FOR WATER SOFTENING SYSTEMS

- A. Primary, Water Softening, Water Mixing Valves:
- B. Standard: 125 psig min, 180°F Max, Ductile Iron ASTM A536 or Bronze ASTM B62, Ductile Iron ASTM A536 or Bronze ASTM B62, Threaded Connections. Exposed- mounting or Cabinet-type,

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.02 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe and in a position to allow full stem movement.
- F. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.
- G. Sectional Valves: Install sectional gate or ball valves closest to main on each branch and riser serving plumbing fixtures or equipment, and where indicated.

- H. Shutoff Valves: Install gate or ball shutoff valve on each water supply to equipment, on each supply to plumbing fixtures without supply stops, and where indicated.
- I. Drain Valves: Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves with cap and chain at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.
- J. Balancing Valves: Install in each hot-water circulation return branch, discharge side of each pump and circulator, and where indicated.

3.03 SOLDERED CONNECTIONS

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Open gate and globe valves to fully open position.
- E. Remove the cap and disc holder of swing check valves having composition discs.
- F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.
- G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.04 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.05 FLANGED CONNECTIONS

- A. Align flange surfaces parallel.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.06 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 - 1. Copper Tube Size, 2-1/2 Inches (DN65) and Smaller: Solder ends.

2. Steel Pipe Sizes, 2-1/2 Inches (DN65) and Smaller: Threaded or grooved end.
3. Steel Pipe Sizes, 3 Inches (DN80) and Larger: Grooved end or flanged.

3.07 APPLICATION SCHEDULE

- A. General Application: Use gate and ball, valves for shutoff duty; globe and ball for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Domestic Water Systems: Use the following valve types:
 1. Ball Valves: Class 150, 600-psi CWP, with stem extension.
- C. Domestic Hot Water Recirculation Systems: Use the following valve types:
 1. Balancing Valves: Automatic or adjustable Ball valves with readout ports.

3.08 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION

SECTION 22 05 48 - VIBRATION CONTROL FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Vibration Isolators.
2. Vibration Isolation Bases.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete
2. Section 09 90 00 - Painting
3. Section 22 05 00 – Common Work Results for Plumbing
4. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: for pipe hanger restraints.
5. Division 22 Piping Sections for flexible pipe connectors.

1.02 REFERENCES

A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. A36 “Standard Specification for Carbon Structural Steel”

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data: Indicate types, styles, materials, and finishes for each type of isolator specified. Include load deflection curves.
2. Shop Drawings: Show designs and calculations, certified by a professional engineer, as required by the local authority, for the following:
 - a. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, and selection of seismic restraints.
 - b. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to the structure and to the supported equipment. Include auxiliary motor slides and rails, and base weights.

1.04 COORDINATION

- A. Coordinate layout and installation of vibration isolation and seismic-restraint devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate size and location of concrete housekeeping and vibration isolation bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03 Sections.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Sections.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers:

1. Cooper B-Line Systems, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

2.02 VIBRATION ISOLATORS

A. Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.

1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
2. Load Range: From 10 to 50 psig and a deflection not less than 0.08 inch per 1 inch of thickness. Do not exceed a loading of 50 psig.

B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.

C. Spring Isolators: Freestanding, laterally stable, open-spring-type isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 1.2 times the rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to a 1/4-inch- thick, rubber isolator pad attached to the baseplate underside. Size baseplates to limit floor loading to 100 psig.
6. Top Plates: Provide threaded studs for fastening and leveling equipment.
7. Finishes: Manufacturer's standard corrosive-resistant finish.

D. Restrained Spring Isolators: Vertically restrained, freestanding, laterally stable, steel open-spring-type isolators.

1. Housing: Welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Factory-drilled baseplate for bolting to structure and bonded to a 1/4-inch thick, rubber isolator pad attached to the baseplate underside. Provide adjustable equipment mounting and leveling bolt.
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 0.8 times the rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.
- E. Rubber Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to formed-steel housings with threaded connections for hanger rods. Color-code to indicate capacity range.
- F. Spring Hangers: Combination spring and elastomeric hanger with coil spring and elastomeric insert in compression.
 1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

2.03 VIBRATION ISOLATION BASES

- A. Fabricated Steel Bases: Structural-steel bases and rails designed and fabricated by the isolation equipment manufacturer. Include equipment static loadings, power transmission, component misalignment, and cantilever loadings.
 1. Fabricate bases to shapes required, with welded structural-steel shapes, plates, and bars conforming to ASTM A36. Include support brackets to anchor base to isolation units. Include prelocated equipment anchor bolts and auxiliary motor slide bases or rails.
 2. Design and fabricate bases to result in the lowest possible mounting height with not less than 1-inch clearance above the floor.
 3. Weld steel angles on frame for outrigger isolation mountings, and provide for anchor bolts and equipment support.
 4. Factory Finish: Manufacturer's standard corrosive-resistant finish.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and anchor vibration-, sound-, and seismic-control products according to manufacturer's written instructions and authorities having jurisdiction.
- B. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.
- C. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required by authorities having jurisdiction.
- D. Install pipe connectors at connections for equipment supported on vibration isolators.

3.02 ADJUSTING AND CLEANING

- A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operations.
- B. Adjust thrust restraints for a maximum of 1/4 inch of movement at start and stop

END OF SECTION

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Identifying Devices and Labels for Plumbing Piping and Equipment
- B. Related Sections:
 - 1. Section 22 05 00 – Common Work Results for Plumbing

1.02 REFERENCES

- A. The American Society of Mechanical Engineers (ASME) Publications:
 - 1. A13.1 "Scheme for the Identification of Piping Systems"
- B. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
 - 1. C1036 "Standard Specification for Flat Glass"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 - 1. Product Data: For identification materials and devices.
 - 2. Samples: Of color, lettering style, and graphic representation required for each identification material and device.

1.04 QUALITY ASSURANCE

- A. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

1.05 SEQUENCING AND SCHEDULING

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 GENERAL

- A. General: Products specified are for applications referenced in other Division 22 Sections. If more than single type is specified for listed applications, selection is Installer's option.
- B. Pipes Including Insulation: Full-band pipe markers, extending 360 degrees around pipe at each location.

2.02 IDENTIFYING DEVICES AND LABELS

- A. Lettering and Graphics:
 - 1. Utilize manufacturer's standard preprinted captions as selected by Owner's Representative.

2. Coordinate names, abbreviations, and other designations used in plumbing identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of plumbing systems and equipment.
 - a. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.
3. Use piping system terms indicated and abbreviate only as necessary for each application length.
 - a. Arrows: Either integrally with piping system service lettering, to accommodate both directions, or as separate unit, on each pipe marker to indicate direction of flow.
- B. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 3 mils thick.
 1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
 2. Color: Comply with ASME A13.1, unless otherwise indicated.
- C. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.
 1. Material: 0.032-inch thick, polished brass.
 2. Size: 1-1/2-inches diameter, unless otherwise indicated.
- D. Valve Tag Fasteners: Brass, wire-link chain and S-hooks.
- E. Access Panel and Equipment Markers: 1/16-inch thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve and equipment identification corresponding to schedules on Drawings. Provide 1/8-inch center hole for attachment.
- F. Valve Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include screws.
 1. Frame: Extruded aluminum.
 2. Glazing: ASTM C1036, Type I, Class 1, Glazing quality B, 2.5-mm, single-thickness glass.

PART 3 EXECUTION

3.01 LABELING AND IDENTIFYING PIPING SYSTEMS

- A. Install pipe markers on each system as indicated below. Include arrows showing normal direction of flow.
 1. Domestic Cold Water.
 2. Domestic Hot Water.
 3. Domestic Hot Water Return.
 4. Sanitary Drain.
 5. Storm Drain.
 6. Condensate.
 7. Vent.

- B. Marker Type: Plastic markers, with application systems. Install on pipe insulation segment where required for hot, noninsulated pipes.
- C. Fasten markers on pipes and insulated pipes by one of following methods:
 - 1. Snap-on application of pretensioned, semirigid plastic pipe marker.
- D. Locate pipe markers where piping is exposed in machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations according to the following:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 - 3. Near penetrations through walls, floors, ceilings, or nonaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.02 VALVE TAGS

- A. Install on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in valve schedule.
- B. Valve Tag Application Schedule: Tag valves according to size, shape, color scheme, and with captions similar to those indicated in the following:
 - 1. Domestic Cold Water
 - 2. Domestic Hot Water
 - 3. Domestic Hot Water Return
 - 4. Gas
- C. Tag Material: Brass.
- D. Tag Size and Shape: According to the following:
 - 1. Cold & Hot Water: 1-1/2 inches round.
 - 2. Gas: 1-1/2 inches round.
- E. Install framed valve schedule in each major mechanical equipment room.
- F. Valve schedule and tag locations shall be shown on record drawings.

3.03 LABELING AND IDENTIFYING PLUMBING EQUIPMENT.

- A. Label all plumbing equipment with designations as indicated in plumbing equipment schedules on Drawings.

3.04 ADJUSTING AND CLEANING

- A. Relocate plumbing identification materials and devices that have become visually blocked by work of this or other Divisions.
- B. Clean faces of identification devices and glass frames of valve charts.

END OF SECTION

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Insulation Materials
2. Jackets
3. Accessories and Attachments
4. Vapor Retarders
5. Under Lavatory Pipe Insulation

B. Related Sections:

1. Section 07 84 00 - Firestopping: Firestopping materials and requirements for penetrations through fire and smoke barriers.
2. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: For pipe insulation shields and protection saddles.

1.02 REFERENCES

A. ASTM International (ASTM) Publications:

1. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"
2. C195 "Standard Specification for Mineral Fiber Thermal Insulating Cement"
3. C196 "Standard Specification for Expanded or Exfoliated Vermiculite Thermal Insulating Cement"
4. C449 "Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement"
5. C450 "Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging"
6. C547 "Standard Specification for Mineral Fiber Pipe Insulation"
7. C553 "Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications"
8. C921 "Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation"

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
2. Shop Drawings:
 - a. Submit Manufactures data for each type of insulation used.
 - b. Application of field-applied jackets.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or similar industry recognized craft training program.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.05 STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.06 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Section 22 05 29 - "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate installation and testing of electric heat tracing.

1.07 SCHEDULING

- A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Avendra, LLC Preferred Manufacturers:
 - 1. Mineral-Fiber Insulation:
 - a. None
- B. Approved Manufacturers:
 - 1. Mineral-Fiber Insulation:
 - a. CertainTeed Corp.
 - b. Knauf Insulation.
 - c. Owens-Corning Fiberglas Corp.
 - 2. Under Lavatory Pipe Insulation:
 - a. "Truebro Lav Guard 2"; IPS Corp

2.02 INSULATION MATERIALS

- A. Mineral-Fiber Insulation:

1. Glass fibers bonded with a thermosetting resin complying with the following:
 - a. Preformed Pipe Insulation: Comply with ASTM C547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 - b. Blanket Insulation: Comply with ASTM C553, Type II, without facing.
 - c. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
 - 1) Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - 2) Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 - d. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
 - e. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C196.
 - f. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.
- B. Prefabricated Thermal Insulating Fitting Covers:
 1. Comply with ASTM C450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.03 FIELD-APPLIED JACKETS

- A. General: ASTM C921, Type 1, unless otherwise indicated.
- B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
 1. Adhesive: As recommended by insulation material manufacturer.
 2. PVC Jacket Color: White or gray.
 3. PVC Jacket Color: Color-code piping jackets based on materials contained within the piping system.
- D. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultraviolet-resistant PVC.
 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 2. Adhesive: As recommended by insulation material manufacturer.

2.04 ACCESSORIES

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd.
 1. Tape Width: 4 inches.

2.05 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.03 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Apply insulation with integral jackets as follows:
1. Pull jacket tight and smooth.
 2. Circumferential Joints: Cover with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- S. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
1. Firestopping and fire-resistive joint sealers are specified in Section 07 84 00 "Firestopping."
- T. Floor Penetrations: Apply insulation continuously through floor assembly.
1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.04 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
 - 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
 - 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
 - 1. Apply preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 - 4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
 - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
 - 3. Cover fittings with standard PVC fitting covers.
- D. Apply insulation to valves and specialties as follows:
 - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
 - 3. Apply insulation to flanges as specified for flange insulation application.
 - 4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

3.05 PLUMBING PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
1. Flexible connectors.
 2. Vibration-control devices.
 3. Fire-suppression piping.
 4. Below-grade piping, unless otherwise indicated.
 5. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.06 FIELD QUALITY CONTROL

- A. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.
- B. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

3.07 INTERIOR INSULATION APPLICATION SCHEDULE

A. General:

1. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
2. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

	<u>Service</u>	<u>Material</u>	<u>Thickness</u>	<u>Field Applied Jacket</u>	<u>Vapor Retarder Required</u>	<u>Finish</u>
B.	Domestic cold water, hot and recirculated hot water, and condensate drains Operating Temperature: 60 to 140 deg. F.	Mineral fiber with jacket	Copper Piping ALL sizes: 1/2"	None	Yes	None
C.	Horizontal Rainwater conductors	Mineral fiber or Cellular glass, with jacket	Cast Iron Pipe, ALL sizes: 1/2"	Foil and paper	Yes	None
D.	Horizontal Rainwater conductors	Mineral fiber or Cellular glass, with jacket	PVC Pipe, ALL sizes: 1/2"	Foil and paper	Yes	None
E.	Roof drain bodies	Mineral fiber or Cellular glass, with jacket	1"	None	Yes	None
F.	Exposed sanitary drains and	"Truebro Lav-Guard 2"		PVC P-trap and supply	No	White

domestic water	as	covers
supplies and	Manufactured	
stops for fixtures	by IPS Corp	
for the disabled		

END OF SECTION

SECTION 22 11 13 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for **[water service]** **[fire-service mains]** **[combined water service and fire-service mains]**.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- F. NSF Compliance:

1. Comply with NSF 14 for plastic potable-water-service piping.[**Include marking "NSF-pw" on piping.**]
2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.4 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution 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 water-distribution service according to requirements indicated:
 1. Notify [Architect] [Construction Manager] [Owner] no fewer than [two] <Insert number> days in advance of proposed interruption of service.
 2. Do not proceed with interruption of water-distribution service without [Architect's] [Construction Manager's] [Owner's] written permission.

1.5 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Soft Copper Tube: [ASTM B 88, Type K (ASTM B 88M, Type A)] [and] [ASTM B 88, Type L (ASTM B 88M, Type B)], water tube, annealed temper.
 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- B. Hard Copper Tube: [ASTM B 88, Type K (ASTM B 88M, Type A)] [and] [ASTM B 88, Type L (ASTM B 88M, Type B)], water tube, drawn temper.
 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- C. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

- D. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Gaskets: AWWA C111, rubber.
- E. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
 - 1. Grooved-End, Ductile-Iron Pipe Appurtenances:
 - 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) Anvil International, Inc.
 - 2) Victaulic Company of America.
 - 3) **<Insert manufacturer's name.>**
- F. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG **[Class 150] [and] [Class 200]**.
 - 1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.
- G. PVC, AWWA Pipe: AWWA C900, **[Class 150] [and] [Class 200]**, with bell end with gasket, and with spigot end.
 - 1. Comply with UL 1285 for fire-service mains if indicated.
 - 2. PVC Fabricated Fittings: AWWA C900, **[Class 150] [and] [Class 200]**, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.
 - 5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.2 JOINING MATERIALS

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.

- B. Brazing Filler Metals: AWS A5.8, BCuP Series.
- C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.
- D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.3 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
 - 1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
 - a. Standard: AWWA C219.

2.4 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
 - 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:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] **<Insert manufacturer's name; product name or designation>** or a comparable product by one of the following:
 - a. American AVK Co.; Valves & Fittings Div.
 - b. American Cast Iron Pipe Co.; American Flow Control Div.
 - c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. East Jordan Iron Works, Inc.
 - f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - g. McWane, Inc.; Kennedy Valve Div.
 - h. McWane, Inc.; M & H Valve Company Div.
 - i. McWane, Inc.; Tyler Pipe Div.; Utilities Div.
 - j. Mueller Co.; Water Products Div.
 - k. NIBCO INC.
 - l. U.S. Pipe and Foundry Company.
 - m. **<Insert manufacturer's name.>**
 - 4. Nonrising-Stem, Metal-Seated Gate Valves:

- a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
 - 1) Standard: AWWA C500.
 - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
5. Nonrising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
6. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:
 - a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 250 psig (1725 kPa).
 - 3) End Connections: Push on or mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
7. OS&Y, Rising-Stem, Metal-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.
 - 1) Standard: AWWA C500.
 - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
 - 3) End Connections: Flanged.
8. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
 - 3) End Connections: Flanged.
- B. UL/FMG, Cast-Iron Gate Valves:
 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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
 - a. American Cast Iron Pipe Co.; American Flow Control Div.
 - b. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - e. McWane, Inc.; Kennedy Valve Div.
 - f. McWane, Inc.; M & H Valve Company Div.
 - g. Mueller Co.; Water Products Div.
 - h. NIBCO INC.
 - i. U.S. Pipe and Foundry Company.
 - j. <Insert manufacturer's name.>
4. UL/FMG, Nonrising-Stem Gate Valves:
 - a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig (1207 kPa).
 - 3) End Connections: Flanged.
5. OS&Y, Rising-Stem Gate Valves:
 - a. Description: Iron body and bonnet and bronze seating material.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 175 psig (1207 kPa).
 - 3) End Connections: Flanged.

C. Bronze Gate Valves:

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.

- g. Red-White Valve Corporation.
 - h. **<Insert manufacturer's name.>**
4. OS&Y, Rising-Stem Gate Valves:
- a. Description: Bronze body and bonnet and bronze stem.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: **175 psig (1207 kPa)**.
 - 3) End Connections: Threaded.
5. Nonrising-Stem Gate Valves:
- a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
 - 1) Standard: MSS SP-80.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

- 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:
- 3. Basis-of-Design Product: Subject to compliance with requirements, provide **[the product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or a comparable product by one of the following:
 - a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - b. East Jordan Iron Works, Inc.
 - c. Flowserve.
 - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - e. McWane, Inc.; Kennedy Valve Div.
 - f. McWane, Inc.; M & H Valve Company Div.
 - g. Mueller Co.; Water Products Div.
 - h. U.S. Pipe and Foundry Company.
 - i. **<Insert manufacturer's name.>**
- 4. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, nonrising-stem, **[metal] [resilient]**-seated gate valve with one raised face flange mating tapping-sleeve flange.

- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately **5 inches (125 mm)** in diameter.
 - 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.6 [CORPORATION VALVES] [AND] [CURB VALVES]

- A. Manufacturers:
 - 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. Amcast Industrial Corporation; Lee Brass Co.
 - b. Ford Meter Box Company, Inc. (The); Pipe Products Div.
 - c. Jones, James Company.
 - d. Master Meter, Inc.
 - e. McDonald, A. Y. Mfg. Co.
 - f. Mueller Co.; Water Products Div.
 - g. Red Hed Manufacturing & Supply.
 - h. **<Insert manufacturer's name.>**
- B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
 - 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 - 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
 - 3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately **3 inches (75 mm)** in diameter.
 - 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.7 WATER METERS

- A. Water meters will be furnished by utility company.
- B. Manufacturers:
 - 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:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
 - a. AMCO Water Metering Systems.
 - b. Badger Meter, Inc.
 - c. Carlon Meter.
 - d. Hays Fluid Controls; a division of ROMAC Industries Inc.
 - e. McCrometer.
 - f. Mueller Co.; Hersey Meters.
 - g. Neptune Technology Group Inc.
 - h. Sensus Metering Systems.
 - i. <Insert manufacturer's name.>
- C. Displacement-Type Water Meters:
 - 1. Description: With bronze main case.
 - a. Standard: AWWA C700.
 - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- D. Compound-Type Water Meters:
 - 1. Description:
 - a. Standard: AWWA C702.
 - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].

2.8 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 - 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:

3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] **<Insert manufacturer's name; product name or designation>** or a comparable product by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Water Technologies, Inc.
 - f. Wilkins; a Zurn company.
 - g. **<Insert manufacturer's name.>**
 4. Standard: **[ASSE 1013] [or] [AWWA C511]**.
 5. Operation: Continuous-pressure applications.
 6. Pressure Loss: **[12 psig (83 kPa)] <Insert pressure>** maximum, through middle 1/3 of flow range.
 7. Size: **<Insert NPS (DN).>**
 8. Design Flow Rate: **<Insert gpm (L/s).>**
 9. Selected Unit Flow Range Limits: **<Insert gpm (L/s).>**
 10. Pressure Loss at Design Flow Rate: **<Insert psig (kPa)>** for **NPS 2 (DN 50)** and smaller; **<Insert psig (kPa)>** for **NPS 2-1/2 (DN 65)** and larger.
 11. Body: Bronze for **NPS 2 (DN 50)** and smaller; **[cast iron with interior lining complying with AWWA C550 or that is FDA approved] [steel with interior lining complying with AWWA C550 or that is FDA approved] [stainless steel]** for **NPS 2-1/2 (DN 65)** and larger.
 12. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; **[flanged] <Insert type>** for **NPS 2-1/2 (DN 65)** and larger.
 13. Configuration: Designed for **[horizontal, straight through] [vertical inlet, horizontal center section, and vertical outlet] [vertical] <Insert configuration>** flow.
 14. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of **NPS 2 (DN 50)** and smaller; OS&Y gate type with flanged ends on inlet and outlet of **NPS 2-1/2 (DN 65)** and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
- B. Double-Check, Backflow-Prevention Assemblies:
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:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] **<Insert manufacturer's name; product name or designation>** or a comparable product by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.

- e. Watts Water Technologies, Inc.
 - f. Wilkins; a Zurn company.
 - g. **<Insert manufacturer's name.>**
- 4. Standard: **[ASSE 1015] [or] [AWWA C510]**.
 - 5. Operation: Continuous-pressure applications, unless otherwise indicated.
 - 6. Pressure Loss: **[5 psig (35 kPa)] <Insert pressure>** maximum, through middle 1/3 of flow range.
 - 7. Size: **<Insert NPS (DN).>**
 - 8. Design Flow Rate: **<Insert gpm (L/s).>**
 - 9. Selected Unit Flow Range Limits: **<Insert gpm (L/s).>**
 - 10. Pressure Loss at Design Flow Rate: **<Insert psig (kPa)>** for **NPS 2 (DN 50)** and smaller; **<Insert psig (kPa)>** for **NPS 2-1/2 (DN 65)** and larger.
 - 11. Body: Bronze for **NPS 2 (DN 50)** and smaller; **[cast iron with interior lining complying with AWWA C550 or that is FDA approved] [steel with interior lining complying with AWWA C550 or that is FDA approved] [stainless steel]** for **NPS 2-1/2 (DN 65)** and larger.
 - 12. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; **[flanged] <Insert type>** for **NPS 2-1/2 (DN 65)** and larger.
 - 13. Configuration: Designed for **[horizontal, straight through] <Insert configuration>** flow.
 - 14. Accessories: Ball valves with threaded ends on inlet and outlet of **NPS 2 (DN 50)** and smaller; OS&Y gate valves with flanged ends on inlet and outlet of **NPS 2-1/2 (DN 65)** and larger.

2.9 WATER METER BOXES

- A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.
 - 1. Option: Base section may be cast-iron, PVC, clay, or other pipe.
- B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.
- C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of **15,000 lb minimum over 10 by 10 inches (6800 kg minimum over 254 by 254 mm)** square.

2.10 CONCRETE VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.
 - 1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.

2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
 - a. Dimension: **24-inch (610-mm)** minimum diameter, unless otherwise indicated.
3. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.
 - a. Dimension: **24-inch- (610-mm-)** minimum diameter, unless otherwise indicated.
4. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.11 FIRE HYDRANTS

A. Dry-Barrel Fire Hydrants:

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide **[the product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or a comparable product by one of the following:
 - a. American AVK Co.; Valves & Fittings Div.
 - b. American Cast Iron Pipe Co.; American Flow Control Div.
 - c. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - d. American Foundry Group, Inc.
 - e. East Jordan Iron Works, Inc.
 - f. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - g. McWane, Inc.; Kennedy Valve Div.
 - h. McWane, Inc.; M & H Valve Company Div.
 - i. Mueller Co.; Water Products Div.
 - j. Troy Valve; a division of Penn-Troy Manufacturing, Inc.
 - k. U.S. Pipe and Foundry Company.
 - l. **<Insert manufacturer's name.>**
4. Description: Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **5-1/4-inch (133-mm)** main valve, drain valve, and **NPS 6 (DN 150)** mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
 - a. Standard: AWWA C502.
 - b. Pressure Rating: **[150 psig (1035 kPa) minimum] [250 psig (1725 kPa)]**.
5. Description: Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **5-1/4-inch (133-mm)** main valve, drain valve, and **NPS 6 (DN 150)** mechanical-

joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.

- a. Standards: UL 246, FMG approved.
- b. Pressure Rating: [150 psig (1035 kPa) minimum] [250 psig (1725 kPa)].
- c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
- d. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
- e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
- f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

B. Wet-Barrel Fire Hydrants:

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
 - a. American AVK Co.; Valves & Fittings Div.
 - b. Jones, James Company.
 - c. McWane, Inc.; Clow Valve Co. Div. (Corona).
 - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - e. Mueller Co.; Water Products Div.
 - f. <Insert manufacturer's name.>
4. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, NPS 6 (DN 150) threaded or flanged inlet, and base section with NPS 6 (DN 150) mechanical-joint inlet. Include interior coating according to AWWA C550.
 - a. Standard: AWWA C503.
 - b. Pressure Rating: 150 psig (1035 kPa) minimum.
5. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, NPS 6 (DN 150) threaded or flanged inlet, and base section with NPS 6 (DN 150) mechanical-joint inlet.
 - a. Standards: UL 246 and FMG approved.
 - b. Pressure Rating: 150 psig (1035 kPa) minimum.
 - c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
 - d. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
 - e. Direction of Opening: Open hydrant valves by turning operating nut to left or counterclockwise.
 - f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

2.12 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide **[the product indicated on Drawings]** **<Insert manufacturer's name; product name or designation>** or a comparable product by one of the following:
 - a. Elkhart Brass Mfg. Co., Inc.
 - b. Fire End & Croker Corporation.
 - c. Guardian Fire Equipment, Inc.
 - d. Kidde Fire Fighting.
 - e. Potter Roemer.
 - f. Reliable Automatic Sprinkler Co., Inc.
 - g. **<Insert manufacturer's name.>**
4. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; **18-inch- (460-mm-)** high brass sleeve; and round escutcheon plate.
 - a. Standard: UL 405.
 - b. Connections: Two **NPS 2-1/2 (DN 65)** inlets and one **[NPS 4 (DN 100)] [NPS 6 (DN 150)]** outlet.
 - c. Connections: **[Three] [Four]** **NPS 2-1/2 (DN 65)** inlets and one **NPS 6 (DN 150)** outlet.
 - d. Connections: Six **NPS 2-1/2 (DN 65)** inlets and one **[NPS 6 (DN 150)] [NPS 8 (DN 200)]** outlet.
 - e. Inlet Alignment: **[Inline, horizontal] [Square]**.
 - f. Finish Including Sleeve: **[Polished chrome-plated] [Rough chrome-plated] [Polished bronze]**.
 - g. Escutcheon Plate Marking: **"[AUTO SPKR] [&] [STANDPIPE]."**

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping [**NPS 3/4 to NPS 3 (DN 20 to DN 80)**] **<Insert pipe size range>** shall be soft copper tube, [**ASTM B 88, Type K (ASTM B 88M, Type A)**] [**ASTM B 88, Type L (ASTM B 88M, Type B)**]; wrought-copper, solder-joint fittings; and brazed joints.
- F. Underground water-service piping [**NPS 4 and NPS 6 (DN 100 and DN 150)**] **<Insert pipe size range>** shall be[**any of**] the following:
 - 1. Soft copper tube, [**ASTM B 88, Type K (ASTM B 88M, Type A)**] [**ASTM B 88, Type L (ASTM B 88M, Type B)**]; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. Ductile-iron, [**push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed**] [**mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical**] joints.
 - 3. **NPS 4 and NPS 6 (DN 100 and DN 150): NPS 6 (DN 150) PVC**, AWWA Class 150 pipe; PVC, AWWA Class 150 molded fittings; and gasketed joints.
- G. Water Meter Box Water-Service Piping [**NPS 3/4 to NPS 2 (DN 20 to DN 50)**] **<Insert pipe size range>** shall be same as underground water-service piping.
- H. Aboveground[**and Vault**] Water-Service Piping [**NPS 3/4 to NPS 3 (DN 20 to DN 80)**] **<Insert pipe size range>** shall be hard copper tube, [**ASTM B 88, Type K (ASTM B 88M, Type A)**] [**ASTM B 88, Type L (ASTM B 88M, Type B)**]; wrought-copper, solder-joint fittings; and brazed joints.
- I. Aboveground [**and vault**] water-service piping [**NPS 4 and NPS 6 (DN 100 and DN 150)**] **<Insert pipe size range>** shall be[**any of**] the following:
 - 1. Hard copper tube, [**ASTM B 88, Type K (ASTM B 88M, Type A)**] [**ASTM B 88, Type L (ASTM B 88M, Type B)**]; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.
- J. Underground Fire-Service-Main Piping [**NPS 4 to NPS 8 (DN 100 to DN 200)**] **<Insert pipe size range>** shall be[**any of**] the following:
 - 1. Ductile-iron, [**push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed**] [**mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical**] [**grooved-end pipe; ductile-iron-pipe appurtenances; and grooved**] joints.
 - 2. PE, Class [**150**] [**200**], fire-service pipe; molded PE fittings; and heat-fusion joints.
 - 3. PVC, AWWA Class 150 pipe listed for fire-protection service; PVC Class 150 fabricated or molded fittings; and gasketed joints.
 - 4. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 200 fabricated fittings; and gasketed joints.

- K. Aboveground[**and Vault**] Fire-Service-Main Piping [**NPS 4 to NPS 8 (DN 100 to DN 200)**]**<Insert pipe size range>** shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
- L. Underground Combined Water-Service and Fire-Service-Main Piping [**NPS 6 to NPS 10 (DN 150 to DN 250)**] **<Insert pipe size range>** shall be[**any of**] the following:
 - 1. Ductile-iron, [**push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed [mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical] [grooved-end pipe; ductile-iron-pipe appurtenances; and grooved]** joints.
 - 2. PVC, AWWA Class [**150**] [**200**] pipe listed for fire-protection service; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.
- M. Aboveground[**and Vault**] Combined Water Service and Fire-Service-Main Piping [**NPS 6 to NPS 10 (DN 150 to DN 250)**] **<Insert pipe size range>** shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for **NPS 3 (DN 80)** and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for **NPS 2 (DN 50)** and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Underground Valves, **NPS 3 (DN 80)** and Larger: AWWA, cast-iron, nonrising-stem, [**metal**] [**resilient**] [**high-pressure, resilient**]-seated gate valves with valve box.
 - 2. Underground Valves, **NPS 4 (DN 100)** and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
 - 3. Use the following for valves in vaults and aboveground:
 - a. Gate Valves, **NPS 2 (DN 50)** and Smaller: Bronze, [**nonrising**] [**rising**] stem.
 - b. Gate Valves, **NPS 3 (DN 80)** and Larger: [**AWWA, cast iron, OS&Y rising stem, metal seated**] [**AWWA, cast iron, OS&Y rising stem, resilient seated**] [**UL/FMG, cast iron, OS&Y rising stem**].

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Division 22 Section "Common Work Results for Plumbing" for piping-system common requirements.

3.5 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than **NPS 2 (DN 50)** with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Make connections **NPS 2 (DN 50)** and smaller with drilling machine according to the following:
 - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
 - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 - 4. Install corporation valves into service-saddle assemblies.
 - 5. Install manifold for multiple taps in water main.
 - 6. Install curb valve in water-service piping with head pointing up and with service box.
- E. Comply with NFPA 24 for fire-service-main piping materials and installation.
 - 1. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- G. Install PE pipe according to ASTM D 2774 and ASTM F 645.
- H. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- I. Bury piping with depth of cover over top at least [**30 inches (750 mm)**] **<Insert dimension>**, with top at least [**12 inches (300 mm)**] **<Insert dimension>** below level of maximum frost penetration.
- J. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- K. Sleeves are specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- L. Mechanical sleeve seals are specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

- M. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.6 JOINT CONSTRUCTION

- A. See Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Make pipe joints according to the following:
 - 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 - 2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
 - 3. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
 - 4. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
 - 5. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
 - 6. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.7 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Concrete thrust blocks.
 - 2. Locking mechanical joints.
 - 3. Set-screw mechanical retainer glands.
 - 4. Bolted flanged joints.
 - 5. Heat-fused joints.
 - 6. Pipe clamps and tie rods.
 - 7. **<Insert devices.>**
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 3. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- C. MSS Valves: Install as component of connected piping system.
- D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.9 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.
- B. Water Meters: Install displacement-type water meters, **NPS 2 (DN 50)** and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.
- C. Water Meters: Install compound-type water meters, **NPS 3 (DN 80)** and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

3.10 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support **NPS 2-1/2 (DN 65)** and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.11 WATER METER BOX INSTALLATION

- A. Install water meter boxes in paved areas flush with surface.
- B. Install water meter boxes in grass or earth areas with top [**2 inches (50 mm)**] **<Insert dimension>** above surface.

3.12 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

3.13 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.
- C. AWWA Fire Hydrants: Comply with AWWA M17.
- D. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.14 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install protective pipe bollards [**on two sides of**] [**on three sides of**] **<Describe arrangement>** each fire department connection. Pipe bollards are specified in Division 05 Section "Metal Fabrications."

3.15 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. See Division 22 Section "Common Work Results for Plumbing" for piping connections to valves and equipment.
- C. Connect water-distribution piping to [**utility water main**] [**existing water main**] **<Insert piping system>**. Use [**tapping sleeve and tapping valve**] [**service clamp and corporation valve**] **<Insert method>**.
- D. Connect water-distribution piping to interior [**domestic water**] [**and**] [**fire-suppression**] piping.
- E. Connect waste piping from concrete vault drains to [**sanitary sewerage system. See Division 22 Section "Facility Sanitary Sewers" for connection to sanitary-sewer**] [**storm-drainage system. See Division 33 Section "Storm Utility Drainage Piping" for connection to storm-sewer**] piping.

3.16 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in **50-psig (350-kPa)** increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to **0 psig (0 kPa)**. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is **2 quarts (1.89 L)** per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.17 IDENTIFICATION

- A. Install continuous underground[**detectable**] warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Division 22 Section "Common Work Results for Plumbing" for identifying devices.

3.18 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pipe and Tube Materials.
2. Fittings.
3. Joining Materials.
4. Polyethylene Encasement.

B. Related Sections:

1. Section 22 05 00 – Common Work Results for Plumbing
2. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
3. Section 22 05 23 – General Duty Valves for Plumbing Piping
4. Section 22 05 19 - Meters and Gages for Plumbing Piping.
5. Section 22 10 03 - Plumbing Specialties
6. Section 31 20 00 - Earthwork
7. Section 33 00 00 - Utility Services: for exterior water service piping.

1.02 REFERENCES

A. The American Society of Mechanical Engineers (ASME) Publications:

1. B1.20.1 "Pipe Threads, General Purpose, Inch"
2. B16.18 "Cast Copper Alloy Solder Joint Pressure Fittings"
3. B16.22 "Wrought Copper and Copper Alloy Solder Joint Pressure Fittings"
4. B16.24 "Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500 and 2500"
5. B31.9 "Building Services Piping"

B. ASTM International (ASTM) Publications:

1. A47 "Standard Specification for Ferritic Malleable Iron Castings"
2. A536 "Standard Specification for Ductile Iron Castings"
3. A674 "Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids"
4. B32 "Standard Specification for Solder Metal"
5. B75 "Standard Specification for Seamless Copper Tube"
6. B88 "Standard Specification for Seamless Copper Water Tube"
7. B584 "Standard Specification for Copper Alloy Sand Castings for General Applications"
8. D1785 "Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120"

9. F437 "Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80"
10. F438 "Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40"
11. F439 "Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80"
12. F441/F441M "Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80"
13. F877 "Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems"
14. F1960 "Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing"
15. F2080 "Standard Specification for Cold-Expansion Fittings With Metal Compression-Sleeves for Cross-Linked Polyethylene (PEX) Pipe"

C. American Water Works Association (AWWA) Publications:

1. C104/ANSI A21.4-03 "Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water"
2. C105/ANSI A21.5-99 "Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems"
3. C110/ANSI A21.10-03 "Standard for Ductile-Iron and Gray-Iron Fittings, 3 In.-48 In. (76 mm-1,219 mm), for Water"
4. C111/ANSI A21.11-00 "Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings"
5. C115/ANSI A21.15-99 "Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges"
6. C151/ANSI A21.51-02 "Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water"
7. C153/ANSI A21.53-00 "Standard for Ductile-Iron Compact Fittings for Water Service"
8. C550 "Protective Epoxy Interior Coatings for Valves and Hydrants"
9. C600 "Installation of Ductile-Iron Water Mains and Their Appurtenances"
10. C606 "Grooved and Shouldered Joints"
11. C651 "Disinfecting Water Mains"
12. C652 "Disinfection of Water-Storage Facilities"

D. American Welding Society (AWS) Publications:

1. A5.8 "Specification For Filler Metals For Brazing And Braze Welding"

1.03 DEFINITIONS

- A. Water Service Piping: Water piping outside building that conveys water to building (by Site Subcontractor).
- B. Service Entrance Piping: Water piping at entry into building between water service piping and water distribution piping (by Plumbing Subcontractor, beginning at 5'-0" outside of building).

- C. Water Distribution Piping: Water piping inside building that conveys water to fixtures and equipment throughout the building.

1.04 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Combined Fire-Protection and Domestic, Service Entrance Piping: 250 psig (provide only where permitted by the authority having jurisdiction).
 - 2. Service Entrance Piping: 160 psig.
 - 3. Water Distribution Piping: 125 psig.

1.05 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data: Water Samples, Test Results, and Reports: Specified in "Field Quality Control" and "Cleaning" articles.

1.06 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- C. Comply with NSF 61, "Drinking Water System Components--Health Effects," Sections 1 through 9 for potable-water piping and components.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. CPVC Piping:
 - a. "Flowguard Gold"; Lubrizol (440-943-4200)
 - b. "Corzam"; Lubrizol (440-943-4200)
 - c. Spears Manufacturing; (800-862-1499)

2.02 PIPE AND TUBE MATERIALS

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. Soft Copper Tube: ASTM B88, Types K and L, water tube, annealed temper.
- C. Hard Copper Tube: ASTM B88, Types L, water tube, drawn temper.
- D. Ductile-Iron Pipe: AWWA C151, 250-psig minimum pressure rating with mechanical- or push-on-joint bell, plain spigot end, and AWWA C104 cement-mortar lining. Include AWWA C111 ductile-iron gland, rubber gasket, and steel bolts with mechanical-joint pipe. Include AWWA C111 rubber gasket with push-on-joint pipe.
- E. Flanged, Ductile-Iron Pipe: AWWA C115 ductile-iron barrel with 250-psig pressure rating and AWWA C104 cement-mortar lining. Include Class 150 or 300, iron-alloy threaded flanges that match piping.

- F. PEX Distribution System: ASTM F877, SDR 9 tubing
- G. CPVC PIPING
 - 1. CPVC Schedule [40] [80] Pipe: ASTM F441/F 441M.
 - a. CPVC Schedule 40 Fittings: ASTM F438, socket type.
 - b. CPVC Schedule 80 Fittings: [ASTM F439, socket] [ASTM F437, threaded] [ASTM F439, socket type or ASTM F437, threaded] type.

2.03 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. Copper, Solder-Joint Pressure Fittings: ASME B16.18 cast-copper alloy or ASME B16.22 wrought copper.
- C. Copper, Grooved-End Fittings: ASTM B75 copper tube or ASTM B584 bronze castings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- E. Copper Unions: ASME B16.18, cast-copper-alloy, hexagonal-stock body with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded, or solder-joint and threaded ends. Include threads conforming to ASME B1.20.1 on threaded ends.
- F. Ductile-Iron, Mechanical- or Push-on-Joint Fittings: AWWA C110, ductile- or gray-iron standard pattern; or AWWA C153, ductile-iron compact pattern; with 250-psig minimum pressure rating and AWWA C104 cement-mortar lining. Include AWWA C111 ductile- or gray-iron glands, rubber gaskets, and steel bolts with mechanical-joint fittings. Include AWWA C111 rubber gaskets with push-on-joint fittings.
- G. PEX TUBE AND FITTINGS
 - 1. PEX Distribution System: ASTM F877, ASTM F1960, SDR 9 tubing.
 - 2. Fittings for PEX Tube: ASTM F1960 and ASTM F2080, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
 - 3. Manifold: Multiple-outlet, copper assembly complying with ASTM F877; with brass or bronze full port ball valve for each outlet. Refer to drawings for exact size and number of outlets per manifold assembly.
- H. Ductile-Iron, Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends conforming to AWWA C110 or AWWA C153. Include 2 gasketed ball-joint sections, 1 or more gasketed sleeve sections, 250-psig minimum working-pressure rating, and AWWA C550 epoxy interior coating. Assemble components for offset and expansion indicated. Include AWWA C111 ductile-iron glands, rubber gaskets, and steel bolts.
- I. Ductile-Iron, Grooved-End Fittings: ASTM A47 malleable-iron castings or ASTM A536 ductile-iron castings with cement-mortar lining or AWWA C550 interior coating and dimensions matching ductile-iron pipe.
- J. Ductile-Iron Flanged Fittings: AWWA C110, ductile- or gray-iron standard pattern; with 250-psig minimum pressure rating and AWWA C104 cement-mortar lining.

- K. Ferrous Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include 150-psig minimum pressure rating, packing rings, packing, limit rods, chrome-plated finish on slip-pipe section, flanged ends, and AWWA C550 epoxy interior coating.
- L. Ferrous, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and 2 slip-pipe sections. Include 150-psig minimum pressure rating, packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, flanged ends, and AWWA C550 epoxy interior coating.

2.04 JOINING MATERIALS

- A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.
- B. Refer to Section 22 05 00 - "Common Work Results for Plumbing" for commonly used joining materials.
- C. Solder: ASTM B32, Alloy Sn95, Sn94, or E; lead free.
- D. Brazing Filler Metal: AWS A5.8, BCuP, copper phosphorus or BAg, silver classification.
- E. Copper, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
- F. Ductile-Iron, Keyed Couplings: AWWA C606 for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
- G. Joints for PEX Piping: Join according to ASTM F1960 and ASTM F2080.
- H. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

PART 3 EXECUTION

3.01 EXCAVATION

- A. Refer to Section 31 20 00 - "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Fitting Option: Mechanically formed tee-branch outlets and brazed joints may be used on aboveground copper tubing.
- D. Underground, Service Entrance Piping: Do not use flanges or valves underground. Use the following:
 - 1. 2-Inch NPS (DN50) and Smaller: Soft copper tube, Type K (Type A); copper, solder-joint pressure fittings; and soldered joints.
 - 2. 2-1/2- to 3-1/2-Inch NPS (DN65 to DN90): Soft copper tube, Type K (Type A); copper, solder-joint pressure fittings; and soldered joints.
 - 3. 4- to 8-Inch NPS (DN100 to DN200): Ductile-iron pipe and fittings, and mechanical or push-on joints.
- E. Aboveground, Water Distribution Piping: Use the following:

1. PEX Distribution System: ASTM F877, SDR 9 tubing, at all suite locations, as hereinafter specified. PEX tubing shall extend from the copper valve manifold to each fixture supply rough-in/ final connection.
 2. 3-1/2-Inch NPS (DN90) and Smaller: Hard copper tube, Type L (Type B); copper, solder-joint fittings; and soldered joints.
 3. 4- to 6-Inch NPS (DN100 to DN150): Hard copper tube, Type L (Type B) with grooved ends; copper, grooved-end fittings; and copper, keyed couplings.
- F. Underground, Water Distribution Piping: Do not use flanges or valves underground. Use the following:
1. 2-Inch NPS (DN50) and Smaller: Soft copper tube, Type L (Type B); wrought-copper, solder-joint pressure fittings; and soldered joints.
 2. 2-1/2- to 4-Inch NPS (DN65 to DN100): Hard copper tube, Type L (Type B); wrought-copper, solder-joint pressure fittings; and soldered joints.
- G. Non-Potable-Water Piping: Use the following:
1. 3-1/2-Inch NPS (DN90) and Smaller: Hard copper tube, Type L (Type B); solder-joint pressure fittings; and soldered joints - or - PVC ASTM D1785, schedule 40.

3.03 PIPING INSTALLATION, GENERAL

- A. Refer to Section 22 05 00 - "Common Work Results for Plumbing" for basic piping installation.

3.04 SERVICE ENTRANCE PIPING INSTALLATION

- A. Extend service entrance piping to exterior water service piping in sizes and locations indicated for service entrances into building. Refer to Section 33 00 00 - "Utilities" for water service piping.
- B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each service entrance pipe per local Utility Code requirements.
- C. Ductile-Iron, Service Entrance Piping: Comply with AWWA C600. Install buried piping between shutoff valve and connection to water service piping with restrained joints. Anchor pipe to wall or floor at entrance. Include thrust-block supports at vertical and horizontal offsets.
1. Encase piping with polyethylene film according to ASTM A674 or AWWA C105 if required by the local authority having jurisdiction.
- D. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Section 22 05 00 - "Common Work Results for Plumbing" for wall penetration systems.

3.05 WATER DISTRIBUTION PIPING INSTALLATION

- A. Install piping with 0.25 percent slope downward toward drain.

3.06 JOINT CONSTRUCTION

- A. Refer to Section 22 05 00 - "Common Work Results for Plumbing" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.07 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section 22 05 29 - "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
 - 1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
 - 2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs 100 feet and less.
 - 3. Adjustable roller hangers, MSS Type 43, for individual, straight, horizontal runs longer than 100 feet.
 - 4. Spring cushion rolls, MSS Type 49, if indicated, for individual, straight, horizontal runs longer than 100 feet.
 - 5. Pipe rolls, MSS Type 44, for multiple, straight, horizontal runs 100 feet or longer. Support pipe rolls on trapeze.
 - 6. Spring hangers, MSS Type 52, for supporting base of vertical runs.
- B. Install supports according to Section 22 05 29 - "Hangers and Supports for Plumbing Piping and Equipment"
- 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 copper tubing with the following maximum spacing and minimum rod diameters:
 - 1. 3/4-Inch NPS (DN20) and Smaller: Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 2. 1-Inch NPS (DN25): Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 3. 1-1/4-Inch NPS (DN32): Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 4. 1-1/2 and 2-Inch NPS (DN40 and DN50): Maximum horizontal spacing, 96 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 5. 2-1/2-Inch NPS (DN65): Maximum horizontal spacing, 108 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 6. 3-Inch NPS (DN80): Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 7. 3-1/2-Inch NPS (DN90): Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 8. 4- and 5-Inch NPS (DN100 and DN125): Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.08 CONNECTIONS

- A. Connect service entrance piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

- B. Connect water distribution piping to service entrance piping at shutoff valve, and extend to and connect to the following:
 - 1. Water Heaters: Connect cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Connect hot- and cold-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section 22 40 00 - "Plumbing Fixtures."
 - 3. Equipment: Connect hot- and cold-water supply piping as indicated. Provide shutoff valve and union for each connection. Use flanges instead of unions for connections 2-1/2-inch NPS (DN65) and larger.
 - 4. Booster Systems (Where required): Connect cold-water suction and discharge piping.

3.09 FIELD QUALITY CONTROL

- A. Inspect service entrance piping and water distribution piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - 2. 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.
 - a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test service entrance piping and water distribution piping as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 3. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.

3.10 CLEANING

- A. Clean and disinfect service entrance piping and water distribution piping as follows:

1. Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for 3 hours.
 - c. Flush system with clean, potable water until chlorine is no longer in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows contamination.
- B. Prepare and submit reports for purging and disinfecting activities.
- C. Clean interior of piping system. Remove dirt and debris as work progresses.

3.11 COMMISSIONING

- A. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- B. Perform the following steps before putting into 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. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.
- C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- D. Check plumbing specialties and verify proper settings, adjustments, and operation.
 1. Water-Pressure Regulators: Set outlet pressure at 80 psig maximum, unless otherwise indicated.
- E. Energize pumps and verify proper operation.

END OF SECTION

SECTION 22 11 23 - DOMESTIC WATER PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Domestic Water Inline Pumps

B. Related Sections:

1. Section 22 05 23 - General Duty Valves for Plumbing Piping
2. Section 22 05 19 - Meters and Gages for Plumbing Piping
3. Section 22 11 16 - "Domestic Water Piping
4. Section 22 11 23.13 - Domestic Water Packaged Booster Pumps: for booster systems.
5. Section 22 34 00 – Fuel-Fired Domestic Water Heaters.
6. Division 26 Sections for power-supply wiring, field-installed disconnects, electrical devices, and motor controllers.

1.02 REFERENCES

A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. B36 “Standard Specification for Brass Plate, Sheet, Strip, And Rolled Bar”
2. B584 “Standard Specification for Copper Alloy Sand Castings for General Applications”

B. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

C. Underwriter's Laboratories, Inc. (UL) Standards:

1. 486A “Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors”
2. 486B “Standard for Wire Connectors for Use With Aluminum Conductors”
3. 778 “Standard for Motor-Operated Water Pumps”

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Product Data:

- a. Include certified performance curves and rated capacities of selected models; shipping, installed, and operating weights; furnished specialties; and accessories for each type and size of pump specified. Indicate pumps' operating point on curves.
2. Maintenance Data: For each pump specified to include in maintenance manuals specified in Division 01.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of pumps through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Domestic Water Inline Pumps:
 - a. Grundfos
 - b. Armstrong Pumps, Inc.
 - c. ITT Industries
 - d. Taco, Inc.

2.02 GENERAL

- A. Description: Factory-assembled and -tested, single-stage, centrifugal pump units; complying with UL 778; suitable for potable-water service; with all-bronze or stainless-steel construction and components in contact with water made of corrosion-resistant materials.
- B. Motors: Comply with requirements in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment" with built-in thermal-overload protection appropriate for motor size and duty.
- C. End Connections for NPS 2 (DN50) and Smaller: Threaded. Pumps available only with flanged ends may be furnished with threaded companion flanges.
- D. End Connections for NPS 2-1/2 (DN65) and Larger: Flanged.
- E. Finish: Manufacturer's standard paint applied to factory-assembled and -tested units before shipping.
- F. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles.

2.03 DOMESTIC WATER IN-LINE PUMPS

- A. Description: Horizontal in-line circulator, rated for 125-psig minimum working pressure and minimum continuous water temperature of 225 deg F.
 - 1. Construction: Radially split, all-bronze casing.
 - 2. Impeller: ASTM B36, rolled brass; or ASTM B584, cast bronze; overhung, single suction, and keyed to shaft.
 - 3. Seal: Mechanical.
 - 4. Shaft and Sleeve: Steel shaft, with oil-lubricated copper sleeve.
 - 5. Pump Bearings: Oil-lubricated, bronze-journal or thrust type.
 - 6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
 - 7. Motor: Single speed, with oil-lubricated bearings, unless otherwise indicated; and resiliently mounted to pump casing.

- a. Motor Size: For motors larger than 1/2 hp, select motor size that will not overload through full range of pump performance curve.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in of water distribution piping to verify actual locations of connections before pump installation.

3.02 INSTALLATION

- A. Install pumps according to manufacturer's written instructions and with access for periodic maintenance, including removing motors, impellers, couplings, and accessories.
- B. Support pumps and piping so weight of each is not supported by the other.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
 1. Connect water distribution piping to pumps. Install suction and discharge pipe equal to or greater than size of pump nozzles. Refer to Section 22 11 16 - "Domestic Water Piping."
 2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Section 22 05 23 - "General Duty Valves for Plumbing Piping" for general-duty valves.
 3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Section 22 05 19 - "Meters and Gages for Plumbing Piping" for pressure gages and gage connectors.
- B. Electrical wiring and connections are specified in Division 26 Sections.
- C. Ground equipment.
 1. 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 and UL 486B.

3.04 COMMISSIONING

- A. Check suction piping connections for tightness.
- B. Final Checks before Starting: Perform the following preventive maintenance operations:
 1. Lubricate oil-lubricated-type bearings.
 2. Verify that pump is free to rotate by hand and that pump for handling hot liquids is free to rotate with pump hot and cold. Do not operate pump if it is bound or drags, until cause of trouble is determined and corrected.
 3. Verify that pump controls are correct for required application.
- C. Starting procedure for pumps is as follows:
 1. Prime pump by opening suction valves and closing drains, and prepare pump for operation.

2. Open circulating line valve if pump should not be operated against dead shutoff.
3. Open discharge valve slowly.
4. Check general mechanical operation of pump and motor.
5. Close circulating line valve once there is sufficient flow through pump to prevent overheating.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain pumps as specified below:
 1. Conduct training as specified in Division 01 Sections.
 2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.

END OF SECTION

SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pipe, Fittings and Joining Materials.
2. Protective Coating.
3. Piping Specialties.
4. Valves.

B. Related Sections:

1. Section 09 90 00 - Painting
2. Section 22 34 00– Fuel-Fired, Domestic Water Heaters
3. Section 23 05 00– Common Work Results for HVAC
4. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: For pipe hanger restraints.
5. Section 33 00 00 - Utility Services: For natural gas service piping, specialties, and accessories outside the building.

1.02 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. Z21.15/CGA 9.1 “Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves”
2. Z21.21 “Automatic Valves for Gas Appliances (same as CSA 6.5)”
3. Z21.24/CGA 6.10 “Connectors for Gas Appliances”
4. Z21.41/CSA 6.9 “Quick Disconnect Devices for Use with Gas Fuel Appliances”

B. The American Society of Mechanical Engineers (ASME) Publications:

1. B1.20.1 "Pipe Threads, General Purpose, Inch"
2. B16.1 “Cast Iron Pipe Flanges and Flanged Fittings”
3. B16.3 “Malleable Iron Threaded Fittings”
4. B16.5 “Pipe Flanges and Flanged Fittings”
5. B16.9 “Factory-Made Wrought Buttwelding Fittings”
6. B16.11 “Forged Fittings, Socket-Welding and Threaded”
7. B16.24 “Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500 and 2500”
8. B16.33 “Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 125 psi (Sizes NPS ½ through NPS 2)”
9. B16.38 “Large Metallic Valves For Gas Distribution (Manually Operated NPS-2 1/2 To 12,125 PSIG Max)”
10. B16.39 “Malleable Iron Threaded Pipe Unions”

- C. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
 - 1. A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"
- D. Manufacturers Standardization Society of the Valve and Fittings Industry. (MSS) Publications:
 - 1. SP-70 "Gray Iron Gate Valves Flanged and Threaded Ends"
 - 2. SP-78 "Socket Welding Reducer Inserts"
- E. National Fire Protection Association (NFPA) Publications:
 - 1. 54 "National Fuel Gas Code (ANSI Z223.1)"
- F. The Society for Protective Coatings (SSPC) Publications:
 - 1. Paint - Paint and Coating Standards and Specifications
 - a. Paint 16 "Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals"
- G. Underwriter's Laboratories, Inc. (UL):
 - 1. "Gas and Oil Equipment Directory"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 - 1. Product Data for the following:
 - a. Corrugated, stainless-steel tubing systems. Include associated components.
 - b. Specialty valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - c. Pressure regulators. Include pressure rating, capacity, and settings of selected models.

1.04 QUALITY ASSURANCE

- A. ANSI Standard: Comply with ANSI Z223.1, "National Fuel Gas Code."
- B. IAS Standard: Provide components listed in IAS's "Directory of A. G. A. and C. G. A Certified Appliances and Accessories" if specified to be IAS listed.
- C. UL Standard: Provide components listed in UL's "Gas and Oil Equipment Directory" if specified to be UL listed.

1.05 PROJECT CONDITIONS

- A. Gas System Pressure: As indicated on Drawings
- B. Design values of fuel gas supplied for these systems are as follows:
 - 1. Nominal Heating Value: As indicated on Drawings.
 - 2. Nominal Specific Gravity: As indicated on Drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers:

1. Corrugated, Stainless-Steel Tubing Systems:
 - a. Omega Flex, Inc.
 - b. Titeflex Corporation
 - c. Tru-Flex Metal Hose Corp.
 - d. B&K Industries, Inc.
 - e. Cimberio Valve Co.
 - f. Conbraco Industries, Inc.; Apollo Div.
2. Gas Valves, NPS 2 (DN 50) and Smaller:
 - a. Crane Valves
 - b. Milwaukee Valve Co., Inc.
 - c. Mueller Co.; Mueller Gas Products Div.
3. Plug Valves, NPS 2-1/2 (DN 65) and Larger:
 - a. Milliken Valve Co., Inc.
 - b. Mueller Co.; Mueller Gas Products Div.
4. Service Pressure Regulators:
 - a. American Meter Co.
 - b. Invensys Metering Systems
 - c. Fisher Controls, Division of Emerson.

2.02 PIPING MATERIALS

- #### A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 PIPES, TUBES, FITTINGS, AND JOINING MATERIALS

- #### A. Steel Pipe: ASTM A53; Type E or S; Grade B; Schedule 40; black.
1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
 2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
 3. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
 4. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
 5. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
 6. Joint Compound and Tape: Suitable for natural gas.
 7. Steel Flanges and Flanged Fittings: ASME B16.5.

8. Gasket Material: Thickness, material, and type suitable for natural gas.

B. Transition Fittings: Type, material, and end connections to match piping being joined.

C. Common Joining Materials: Refer to Section 23 05 00 - "Common Work Results for HVAC" for joining materials not in this Section.

2.04 PROTECTIVE COATING

A. Paint all exterior exposed gas piping with two coats of rust inhibitive paint.

2.05 PIPING SPECIALTIES

A. Flexible Connectors: ANSI Z21.24, copper alloy.

B. Quick-Disconnect Devices: ANSI Z21.41, convenience outlets and matching plug connector.

C. Valves, NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

D. Valves, NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

E. Appliance Connector Valves: ANSI Z21.15 and IAS listed.

F. Gas Stops: Bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 2-psig (13.8-kPa) minimum pressure rating.

G. Gas Valves, NPS 2 (DN 50) and Smaller: ASME B16.33 and IAS-listed bronze body and 125-psig pressure rating.

H. Plug Valves, NPS 2-1/2 (DN 65) and Larger: ASME B16.38 and MSS SP-78 cast-iron, lubricated plug valves, with 125-psig pressure rating.

I. General-Duty Valves, NPS 2-1/2 (DN 65) and Larger: ASME B16.38, cast-iron body, suitable for fuel gas service, with "WOG" indicated on valve body, and 125-psig pressure rating.

1. Gate Valves: MSS SP-70, OS&Y type with solid wedge.

2.06 PREPARATION

A. Comply with NFPA 54 (ANSI Z223.1), "Prevention of Accidental Ignition" Paragraph.

2.07 SERVICE ENTRANCE PIPING

A. Extend fuel gas piping and connect to fuel gas distribution for service entrance to building.

1. Exterior fuel gas distribution system piping, service pressure regulator, and service meter will be provided by gas utility.

B. Install strainer upstream from each earthquake valve. Refer to Section 22 10 13 - "Plumbing Specialties" for strainers.

2.08 CONCRETE BASE INSTALLATION

A. Locate bases at service meters and service regulators.

B. Excavate earth and make level beds to support bases. Set bases level with top surface projecting approximately 3 inches above grade.

2.09 PIPING APPLICATIONS

- A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.
- B. Fuel Gas Piping, 0.5 psig or Less: Use the following:
 - 1. NPS 3/4 (DN 20) steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 2. NPS 3/4 and NPS 1 (DN 20 and DN 25): Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - a. Option: Soft copper tube, copper fittings, and brazed joints may be used for runouts at individual appliances.
 - 3. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 4. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Steel pipe, steel welding fittings, and welded joints.
 - 5. Larger Than NPS 4 (DN 100): Steel pipe, steel welding fittings, and welded joints.

2.10 VALVE APPLICATIONS

- A. Appliance Shutoff Valves for Pressure 0.5 psig or Less: Appliance connector valve or gas stop.
- B. Appliance Shutoff Valves for Pressure 0.5 to 2 psig: Gas stop or gas valve.
- C. Piping Line Valves, NPS 2 (DN 50) and Smaller: Gas valve.
- D. Piping Line Valves, NPS 2-1/2 (DN 65) and Larger: Plug valve or general-duty valve.
- E. Valves at Service Meter, NPS 2 (DN 50) and Smaller: Gas valve.
- F. Valves at Service Meter, NPS 2-1/2 (DN 65) and Larger: Plug valve.

2.11 PIPING INSTALLATION

- A. Refer to Section 23 05 00 - "Common Work Results for HVAC" for basic piping installation requirements.
- B. Concealed Locations: Except as specified below, install concealed gas piping in airtight conduit constructed of Schedule 40, seamless, black steel pipe with welded joints. Vent conduit to outside and terminate with screened vent cap.
 - 1. Above-Ceiling Locations: Gas piping may be installed in accessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves above ceilings.
 - 2. In Partitions: Do not install concealed piping in solid partitions. Protect tubing from physical damage when installed inside partitions or hollow walls.
 - a. Exception: Tubing passing through partitions or walls.
 - 3. In Walls: Gas piping with welded joints and protective wrapping specified in "Protective Coating" Article in Part 2 may be installed in masonry walls, subject to approval of authorities having jurisdiction.
 - 4. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.

- a. Exception: Accessible above-ceiling space specified above.
- C. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches (75 mm) long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- D. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, unless indicated to be exposed to view.
- E. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.
- F. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- G. Connect branch piping from top or side of horizontal piping.
- H. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- I. Install corrugated, stainless-steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.
- J. Install strainer on inlet of each line pressure regulator and automatic and electrically operated valve.
- K. Install flanges on valves, specialties, and equipment having NPS 2-1/2 (DN 65) and larger connections.
- L. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.

2.12 JOINT CONSTRUCTION

- A. Refer to Section 23 05 00 "Common Work Results for HVAC" for basic piping joint construction.
- B. Use materials suitable for fuel gas.
 - 1. Brazed Joints: Make with brazing alloy with melting point greater than 1000 deg F. Brazing alloys containing phosphorus are prohibited.

2.13 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section 23 05 29 - "Hangers and Supports for HVAC Piping and Equipment" for pipe hanger and support devices.
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4 (DN 32): Maximum span, 108 inches; minimum rod size, 3/8 inch.

3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

2.14 CONNECTIONS

- A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.
- B. Install piping adjacent to appliances to allow service and maintenance.
- C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

2.15 PAINTING

- A. Use materials and procedures in Section 09 90 00 "Painting"
- B. Paint exterior service meters, pressure regulators, specialty valves, and piping.
 1. Color: Gray.

2.16 FIELD QUALITY CONTROL

- A. Inspect, test, and purge piping according to NFPA 54 (ANSI Z223.1), Part 4 "Inspection, Testing, and Purging," and requirements of authorities having jurisdiction.
- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- C. Report test results promptly and in writing to Owner's Representative and authorities having jurisdiction.
- D. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.
- E. Verify correct pressure settings for pressure regulators.
- F. Verify that specified piping tests are complete.

2.17 ADJUSTING

- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION

SECTION 22 13 13 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Nonpressure and pressure couplings.
3. Expansion joints.
4. Cleanouts.
5. Encasement for piping.
6. Manholes.

1.2 SUBMITTALS

- A. Product Data: For expansion joints.
- B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.
- C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
- E. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, **[Service class] [Service and Extra-Heavy classes] [and] [Extra-Heavy class]**.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI-Trademark, Shielded Couplings:

1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. ANACO-Husky.
 - b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Mission Rubber Company; a division of MCP Industries, Inc.
 - e. Stant; a Tompkins company.
 - f. Tyler Pipe.
 - g. **<Insert manufacturer's name>**.
3. Description: ASTM C 1277 and CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Shielded Couplings:

1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. Mission Rubber Company; a division of MCP Industries, Inc.
 - e. Stant; a Tompkins company.
 - f. Tyler Pipe.
 - g. **<Insert manufacturer's name>**.
3. Description: ASTM C 1277 and ASTM C 1540, with stainless-steel shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 PVC PIPE AND FITTINGS

A. PVC Corrugated Sewer Piping:

1. Pipe: ASTM F 949, PVC corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F 477, elastomeric seals.

B. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, [SDR 35] <Insert SDR>, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

2.4 CONCRETE PIPE AND FITTINGS

- A. Nonreinforced-Concrete Sewer Pipe and Fittings: ASTM C 14 (ASTM C 14M), [Class 1] [Class 2] [Class 3], with [bell-and-spigot] [or] [tongue-and-groove] ends for gasketed joints with ASTM C 443 (ASTM C 443M), rubber gaskets.
- B. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M).
1. [Bell-and-spigot] [or] [tongue-and-groove] ends for gasketed joints, with ASTM C 443 (ASTM C 443M), rubber gaskets.
 2. Class II, [Wall A] [Wall B] [Wall C].
 3. Class III, [Wall A] [Wall B] [Wall C].
 4. Class IV, [Wall A] [Wall B] [Wall C].
 5. Class V, [Wall A] [Wall B].

2.5 NONPRESSURE-TYPE TRANSITION COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 2. For Concrete Pipes: ASTM C 443 (ASTM C 443M), rubber.
 3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings:
1. Description: Elastomeric sleeve with [stainless-steel shear ring and] corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Ring-Type, Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.6 EXPANSION JOINTS

- A. Ductile-Iron, Flexible Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. EBAA Iron, Inc.
 - b. Romac Industries, Inc.
 - c. Star Pipe Products.
 - d. **<Insert manufacturer's name>**.
3. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for **250-psig (1725-kPa)** minimum working pressure and for offset and expansion indicated.

2.7 CLEANOUTS

- A. Cast-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
 1. Top-Loading Classification(s): **[Light Duty] [Medium Duty] [Heavy Duty] [and] [Extra-Heavy Duty]**.
 2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.8 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: **[Linear low-density polyethylene film of 0.008-inch (0.20-mm)] [or] [high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm)]** minimum thickness.
- C. Form: **[Sheet] [or] [tube]**.
- D. Color: **[Black] [or] [natural] <Insert color>**.

2.9 MANHOLES

- A. Standard Precast Concrete Manholes:
 1. Description: **ASTM C 478 (ASTM C 478M)**, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 2. Diameter: **48 inches (1200 mm)** minimum unless otherwise indicated.
 3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.

4. Base Section: **6-inch (150-mm)** minimum thickness for floor slab and **4-inch (100-mm)** minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: **4-inch (100-mm)** minimum thickness, of length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
7. Joint Sealant: **ASTM C 990 (ASTM C 990M)**, bitumen or butyl rubber.
8. Resilient Pipe Connectors: **ASTM C 923 (ASTM C 923M)**, cast or fitted into manhole walls, for each pipe connection.
9. Steps: [**Individual FRP steps or FRP ladder**] [**Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP**] [**ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP**] **<Insert material>**; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals. Omit steps if total depth from floor of manhole to finished grade is less than [**60 inches (1500 mm)**] **<Insert dimension>**.
10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; **24-inch (610-mm)** ID by **7- to 9-inch (175- to 225-mm)** riser, with **4-inch- (100-mm-)** minimum-width flange and **26-inch- (660-mm-)** diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: [**ASTM A 536, Grade 60-40-18 ductile**] [**ASTM A 48/A 48M, Class 35 gray**] iron unless otherwise indicated.

2.10 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, **ACI 350/350R (ACI 350M/350RM)**, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: **4000 psi (27.6 MPa)** minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
 - 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: [1] [2] percent through manhole.
 - 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: [4] [8] percent.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.
 - 1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
 - 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of [1] [2] <Insert number> percent unless otherwise indicated.
 2. Install piping [NPS 6 (DN 150)] <Insert value> and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
 3. Install piping with [36-inch (915-mm)] [48-inch (1220-mm)] [60-inch (1520-mm)] [72-inch (1830-mm)] <Insert dimension> minimum cover.
 4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
 5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
 6. Install PVC corrugated sewer piping according to ASTM D 2321 and ASTM F 1668.
 7. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
 8. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
 9. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
- G. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:
1. Hub-and-spigot, cast-iron soil pipe.
 2. Hubless cast-iron soil pipe and fittings.
 3. Expansion joints.
- H. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
 3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
 4. Join PVC corrugated sewer piping according to ASTM D 2321.
 5. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
 6. Join nonreinforced-concrete sewer piping according to ASTM C 14 (ASTM C 14M) and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
 7. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
 8. Join dissimilar pipe materials with nonpressure-type, flexible[or rigid] couplings.
- B. Pipe couplings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Unshielded flexible couplings for pipes of same or slightly different OD.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Install FRP manholes according to manufacturer's written instructions.
- D. Form continuous concrete channels and benches between inlets and outlet.
- E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops [**3 inches (76 mm)**] **<Insert dimension>** above finished surface elsewhere unless otherwise indicated.
- F. Install manhole-cover inserts in frame and immediately below cover.

3.5 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.6 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 1. Use Light-Duty, top-loading classification cleanouts in [**earth or unpaved foot-traffic**] **<Insert other>** areas.
 2. Use Medium-Duty, top-loading classification cleanouts in [**paved foot-traffic**] **<Insert other>** areas.
 3. Use Heavy-Duty, top-loading classification cleanouts in [**vehicle-traffic service**] **<Insert other>** areas.
 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in [**roads**] **<Insert area>**.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, [**18 by 18 by 12 inches (450 by 450 by 300 mm)**] **<Insert dimensions>** deep. Set with tops [**1 inch (25 mm)**] **<Insert dimension>** above surrounding grade.

- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."
- B. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus **6-inch (150-mm)** overlap with not less than **6 inches (150 mm)** of concrete with 28-day compressive strength of **3000 psi (20.7 MPa)**.
 - 2. Make branch connections from side into existing piping, **NPS 4 to NPS 20 (DN 100 to DN 500)**. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than **6 inches (150 mm)** of concrete with 28-day compressive strength of **3000 psi (20.7 MPa)**.
 - 3. Make branch connections from side into existing piping, **NPS 21 (DN 525)** or larger, or to underground manholes by cutting opening into existing unit large enough to allow **3 inches (76 mm)** of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in **6 inches (150 mm)** of concrete for minimum length of **12 inches (300 mm)** to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of **3000 psi (20.7 MPa)** unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Connect to **[grease] [oil] [and] [sand]** interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

3.8 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
 - 1. Use **[warning tape or]** detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.9 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately **24 inches (600 mm)** of backfill is in place, and again at completion of Project.
 - 1. Submit separate report for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Fill sewer piping with water. Test with pressure of at least **10-foot (3-m)** head of water, and maintain such pressure without leakage for at least 15 minutes.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.
 - e. Test and inspect joints for leaks.
 - 6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
 - b. Option: Test concrete gravity sewer piping according to **ASTM C 924 (ASTM C 924M)**.
 - 7. Manholes: Perform hydraulic test according to **ASTM C 969 (ASTM C 969M)**.
- C. Leaks and loss in test pressure constitute defects that must be repaired.

- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.10 CLEANING

- A. Clean dirt and superfluous material from interior of piping.[**Flush with potable water.**]

END OF SECTION 221313

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pipe Materials.
2. Fittings.
3. Joining Materials.

B. Related Sections:

1. Section 07 84 00 - Firestopping: for fire-barrier sealers.
2. Section 08 31 00 - Access Doors: for access panels to concealed components.
3. Section 09 90 00 - Painting: for field-applied finishes for piping.
4. Section 11 31 00 -Residential Appliances: for drainage and vent services for clothes washers.
5. Section 11 40 00 - Food Service Equipment: for drainage and vent services for food service equipment.
6. Section 22 05 00– Common Work Results for Plumbing
7. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
8. Section 22 05 53– Identification for Plumbing Piping and Equipment.
9. Section 22 07 00 - Plumbing Insulation.
10. Section 22 30 00 - Plumbing Equipment.
11. Section 22 40 00 - Plumbing Fixtures.
12. Section 31 20 00– Earth Moving: for excavating, trenching, and backfilling.
13. Section 33 00 00 - Utilities
14. Section 33 46 00 - Subdrainage

1.02 REFERENCES

A. The American Society of Mechanical Engineers (ASME) Publications:

1. B31.9 “Building Services Piping”
2. B16.1 “Cast Iron Pipe Flanges and Flanged Fittings”
3. B16.4 “Gray Iron Threaded Fittings: (Classes 125 and 250)”
4. B16.12 “Cast Iron Threaded Drainage Fittings”
5. B16.23 “Cast Copper Alloy Solder Joint Drainage Fittings: DWV”
6. B16.29 “Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings-DWV”

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

1. A48 "Standard Specification for Gray Iron Castings"

2. A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"
 3. A74 "Standard Specification for Cast Iron Soil Pipe and Fittings"
 4. A666 "Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar"
 5. A674 "Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids"
 6. A888 "Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications"
 7. B306 "Standard Specification for Copper Drainage Tube (DWV)"
 8. C564 "Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings"
 9. C1173 "Standard Specification for Flexible Transition Couplings for Underground Piping Systems"
 10. C1277 "Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings"
 11. D2321 "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications"
 12. D2665 "Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings"
 13. D3311 "Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns"
 14. F402 "Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings"
 15. F409 "Standard Specification for Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings"
 16. F477 "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe"
 17. F891 "Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core"
- C. American Water Works Association (AWWA) Publications:
1. C105/ANSI A21.5-99 "Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems"
 2. C110/ANSI A21.10 "Standard for Ductile-Iron and Gray-Iron Fittings, 3 In.-48 In. (76 mm-1,219 mm), for Water "
 3. C111/ANSI A21.11 "Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings"
 4. C151/ANSI A21.51-02 "Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water"
 5. C153/ANSI A21.53-00 "Standard for Ductile-Iron Compact Fittings for Water Service"
 6. C600 "Installation of Ductile-Iron Water Mains and Their Appurtenances"
- D. Cast Iron Soil Pipe Institute (CISPI) Publications:
1. "Cast Iron Soil Pipe and Fittings Handbook"

2. 302 "Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications"

E. NFS International (NFS) Publications:

1. NSF/ANSI 14 "Plastics Piping Components and Related Materials"

1.03 DEFINITIONS

- A. Sewerage Piping: Building sewer piping outside building that conveys sanitary sewage from building (by Site Contractor).
- B. Drainage Piping: Building sewer piping outside building that conveys storm drainage from building (by Plumbing Contractor, beginning at 5'-0" outside of building.)
- C. Service Entrance Piping: Drainage piping at entry into building between outside building sewer piping and inside drainage piping (by Site Contractor).
- D. Drainage and Vent Piping: Piping inside building that conveys waste water and vapors from fixtures and equipment throughout the building.
- E. Force-Main Piping: Drainage piping, under pressure (where required due to local conditions).
- F. The following are industry abbreviations for plastic and other piping materials:
 1. PVC: Polyvinyl chloride.

1.04 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 1. Soil, Waste, and Vent Systems: 10-foot head of water.
 2. Storm Drainage Systems: 10-foot head of water.
 3. Sewage, Force-Main Piping Systems: 100 psig (only where required due to local conditions).

1.05 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 1. Product Data:
 2. Test Results and Reports: Specified in "Field Quality Control" Article.

1.06 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. Hub-and-Spigot, Cast-Iron Soil Pipe: ASTM A74, Service weight ASTM C564 rubber gasket.
- C. Hubless, Cast-Iron Soil Pipe: ASTM A888 or CISPI 301.
- D. PVC Plastic Pipe: ASTM D2665, Schedule 40.
- E. Steel Pipe: ASTM A53.
- F. Ductile Iron Pipe: AWWA C151.
- G. Copper Tubing: ASTM B306.
- H. PVC Piping
 - 1. PVC Pipe: ASTM D2665, solid-wall drain, waste, and vent.
 - a. PVC Socket Fittings: ASTM D2665, made to ASTM D3311, drain, waste, and vent patterns.
 - 2. Cellular-Core, Schedule 40, PVC Pipe: ASTM F891, Schedule 40.
 - a. PVC Socket Fittings: ASTM D2665, made to ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
 - 3. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F891, Series PS 100.
 - a. PVC Socket Fittings: ASTM D2665, made to ASTM D3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.

2.02 JOINING MATERIALS

- A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.
- B. Refer to Section 22 95 00 - "Common Work Results for Plumbing" for commonly used joining materials.
- C. Hubless, Cast-Iron, Soil-Piping Couplings: ASTM C1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C564 rubber sleeve or gasket with integral, center pipe stop. Include the following:
 - 1. Heavy-Duty, Stainless-Steel couplings: ASTM A666, Type 304, stainless-steel housing or shield; and stainless-steel clamps. Include gasket.
 - a. Clamp Width: 3 inches wide with 4 clamps, for piping 1-1/2- to 4-inch NPS.
 - b. Clamp Width: 4 inches wide with 6 clamps, for piping 5- to 10-inch NPS.
 - 2. Heavy-Duty, FM-Approved, Stainless-Steel Couplings: ASTM A666, Type 304, stainless-steel housing; and stainless-steel clamps. Include gasket or bushing.
 - a. Clamp Width: 3 inches wide with 2 clamps, for piping 1-1/2- to 4-inch NPS.
 - b. Clamp Width: 4 inches wide with 2 clamps, for piping 5- to 10-inch NPS.
 - 3. Heavy-Duty, Cast-Iron Couplings: ASTM A48, 2-piece, cast-iron housing; and stainless-steel bolts and nuts. Include gasket.

- D. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.
- E. Flexible, Transition Couplings for Underground, Nonpressure Piping: ASTM C1173 with elastomeric sleeve. Include ends same sizes as piping to be joined and include corrosion-resistant metal band on each end.
 - 1. Sleeve Type for Plain-End Piping: Rubber or elastomeric sleeve and stainless-steel band assembly, fabricated to match outside diameters of piping to be joined. Include the following:
 - a. Sleeves for Cast-Iron Soil Piping: ASTM C564 rubber.
 - b. Sleeves for Plastic Piping: ASTM F477 elastomeric seal.
 - c. Sleeves for Dissimilar Piping: Compatible with piping materials to be joined.
 - d. Bands: Stainless steel, one at each pipe insert.
 - 2. Gasket Type for Dissimilar-End Piping: Rubber or elastomeric compression gasket, made to match inside diameter of pipe or hub, and outside diameter of adjoining pipe. Include the following:
 - a. Gaskets for Cast-Iron Soil Piping: ASTM C564 rubber.
 - b. Gaskets for Plastic Piping: ASTM F477 elastomeric seal.
 - c. Gaskets for Dissimilar Piping: Compatible with piping materials to be joined.

2.03 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. Hub-and-Spigot, Cast-Iron, Soil-Pipe Fittings: ASTM A74, Service weighthub and spigot. Include ASTM C564 rubber gasket for each hub.
- C. Hubless, Cast-Iron, Soil-Pipe Fittings: CISPI 301.
- D. Ferrous Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe section, and flanged ends.
- E. Ferrous, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and 2 slip-pipe sections. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.
- F. PVC Socket Fittings: ASTM D2665, made to ASTM D3311 drain, waste, and vent pipe patterns.
- G. PVC Plastic, Tubular Fittings: ASTM F409 drainage pattern, with ends as required for application.
- H. Steel Pipe Fittings:
 - 1. Cast-Iron, Threaded, Drainage Fittings: ASME B16.12 [galvanized].
 - 2. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, [galvanized,] standard pattern.
 - 3. Cast-Iron Flanges: ASME B16.1, Class 125.
 - 4. Cast-Iron, Flanged Fittings: ASME B 16.1, Class 125 [galvanized].
- I. Ductile Iron Pipe Fittings:

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile or gray-iron glands, rubber gaskets, and steel bolts.

J. Copper Tube Fittings:

1. ASME B16.23, cast copper or ASME B16.29 wrought copper, solder-joint fittings.

PART 3 EXECUTION

3.01 EXCAVATION

- A. Refer to Section 31 20 00 - "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Aboveground, Soil, Waste, and Vent Piping: Use the following:
1. 1-1/2-Inch NPS: Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and one of the following hubless, cast-iron, soil-piping couplings:
 - a. Couplings: Heavy-duty, cast iron.
 2. 2- to 4-Inch NPS: Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
 3. 2- to 4-Inch NPS: Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and one of the following hubless, cast-iron, soil-piping couplings:
 - a. Couplings: Heavy-duty, cast iron.
 4. 5- and 6-Inch NPS (DN125 and DN150): Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and one of the following hubless, cast-iron, soil-piping couplings:
 - a. Couplings: Heavy-duty, cast iron.
- D. Underground, Soil, Waste, and Vent Piping: Use the following:
1. 2- to 4-Inch NPS (DN50 to DN100): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
 2. 5- and 6-Inch NPS (DN125 and DN150): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
 3. 8-Inch NPS (DN200): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
- E. Aboveground, Storm Drainage Piping: Use the following:
1. 2- to 4-Inch NPS (DN50 to DN100): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and compression joints.
 - a. Couplings: Heavy-duty, cast iron.
 2. 5- and 6-Inch NPS (DN125 and DN150): Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and one of the following hubless, cast-iron, soil-piping couplings:
 - a. Couplings: Heavy-duty, cast iron.

F. Underground, Storm Drainage Piping: Use the following:

1. 3- and 4-Inch NPS (DN80 and DN100): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
2. 5- and 6-Inch NPS (DN125 and DN150): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
3. 8-Inch NPS (DN200): PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

3.03 PIPING INSTALLATION, GENERAL

- A. Refer to Section 22 95 00 - "Common Work Results for Plumbing" for basic piping installation.

3.04 SERVICE ENTRANCE PIPING INSTALLATION

- A. Refer to Section 33 00 00 - "Utilities" for sanitary piping and refer to Section 33 46 00 "Subdrainage" for storm piping.
- B. Extend building sanitary drain piping and connect to sanitary sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building sanitary drains with building sanitary sewers.
- C. Extend building storm drain piping and connect to storm sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building storm drains and building storm sewers.

3.05 DRAINAGE AND VENT PIPING INSTALLATION

- A. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- B. Make changes in direction for drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.
- C. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- D. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:
1. Sanitary Building Drain: 2 percent downward in direction of flow for piping 3-inch NPS (DN80) and smaller; 1 percent downward in direction of flow for piping 4-inch NPS (DN100) and larger.
 2. Horizontal, Sanitary Drainage Piping: 2 percent downward in direction of flow.
 3. Storm Building Drain: 1 percent downward in direction of flow.
 4. Horizontal, Storm Drainage Piping: 2 percent downward in direction of flow.

5. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- E. Install engineered, controlled-flow, storm drainage systems in locations indicated. Comply with standards of authorities having jurisdiction.
- F. Sleeves are not required for cast-iron soil piping passing through concrete slab on grade if slab is without membrane waterproofing.
- G. Install PVC plastic drainage piping according to ASTM D2665.
- H. Install underground, PVC plastic drainage piping according to ASTM D2321.

3.06 JOINT CONSTRUCTION

- A. Refer to Section 22 95 00 - "Common Work Results for Plumbing" for basic piping joint construction.
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 1. Compression Joints: Make with rubber gasket matching class of pipe and fittings.
 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. Grooved Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- D. PVC Piping Joints: Join drainage piping according to ASTM D2665.
- E. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F402 for safe handling during joining of plastic pipe and fittings.

3.07 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section 22 05 29 - "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
 1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
 2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs 100 feet and less.
 3. Adjustable roller hangers, MSS Type 43, for individual, straight, horizontal runs longer than 100 feet.
 4. Spring cushion rolls, MSS Type 49, if indicated, for individual, straight, horizontal runs longer than 100 feet.
 5. Pipe rolls, MSS Type 44, for multiple, straight, horizontal runs 100 feet or longer. Support pipe rolls on trapeze.
 6. Spring hangers, MSS Type 52, for supporting base of vertical runs.
- B. Install supports according to 22 05 29 - "Hangers and Supports for Plumbing Piping and Equipment"
- 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 spacing and minimum rod diameters:

1. 1-1/2- and 2-Inch NPS (DN40 and DN50): Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 2. 3-Inch NPS (DN80): Maximum horizontal spacing, 60 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 3. 4- and 5-Inch NPS (DN100 and DN125): Maximum horizontal spacing, 60 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 4. 6-Inch NPS (DN150): Maximum horizontal spacing, 60 inches with 3/4-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 5. 8- through 12-Inch NPS (DN200 through DN300): Maximum horizontal spacing, 60 inches with 7/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 6. Spacing for horizontal pipe in 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install hangers for PVC plastic piping with the following maximum spacing and minimum rod diameters:
1. 1-1/2- and 2-Inch NPS (DN40 and DN50): Maximum horizontal spacing, 48 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
 2. 4- and 5-Inch NPS (DN100 and DN125): Maximum horizontal spacing, 48 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
 3. 6-Inch NPS (DN150): Maximum horizontal spacing, 48 inches with 3/4-inch minimum rod diameter; maximum vertical spacing, 48 inches.
 4. 8- through 12-Inch NPS (DN200 through DN300): Maximum horizontal spacing, 48 inches with 7/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.08 CONNECTIONS

- A. Connect service entrance piping to exterior sewerage and drainage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage piping to service entrance piping, and extend to and connect to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section 22 40 00 "Plumbing Fixtures."
 2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section 22 10 13 - "Plumbing Specialties."
 3. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections 2-1/2-inch NPS (DN65) and larger.
- C. Connect force-main piping to service entrance piping, and extend to and connect to the following:
1. Sump Pumps: Connect force-main piping to sump-pump discharge.

3.09 FIELD QUALITY CONTROL

- A. Inspect drainage and vent piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - 2. 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.
 - a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, 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 has been covered or concealed before it has been tested and approved.
 - 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 feet of head. Water level must not drop from 15 minutes before inspection starts through completion of inspection. 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 using new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of water-based latex paint.

END OF SECTION

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Backflow Preventers
2. Water Regulators
3. Thermostatic Mixing Valves
4. Clothes Washer Drain & Supply
5. Hydrants
6. Trap Primer Valves
7. Drain Valves
8. Backwater Valves
9. Floor Drains
10. Roof Drains
11. Grease Interceptors
12. Lint Interceptors
13. Miscellaneous Piping Specialties

B. Related Sections:

1. Section 22 05 00 – Common Work Results for Plumbing
2. Section 22 05 23 – General Duty Valves for Plumbing Piping
3. Section 22 05 53 – Identification for Plumbing Piping and Equipment: for labeling and identifying requirements.
4. Section 22 05 19 - Meters and Gages for Plumbing Piping
5. Section 22 11 16 - Domestic Water Piping
6. Section 22 13 16 - Drainage and Vent Piping
7. Section 22 40 00 – Plumbing Fixtures and Plumbing Fixture Matrix

1.02 REFERENCES

A. The American Society of Mechanical Engineers (ASME) Publications:

1. A112.1.2 “Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)”
2. A112.14.1 “Backwater Valves”
3. A112.3.1 “Grate Openings”
4. A112.21.1M “Floor Drains”
5. A112.21.2M “Roof Drains”
6. A112.21.3M “Hydrants for Utility and Maintenance Use”

7. B1.20.7 "Hose Coupling Screw Threads, Inch"
8. B31.9 "Building Services Piping"
- B. American Society of Sanitary Engineering (ASSE) Publications:
 1. 1001 "Performance Requirements for Atmospheric Type Vacuum Breakers"
 2. 1003 "Performance Requirements for Water Pressure Reducing Valves"
 3. 1010 "Performance Requirements for Water Hammer Arresters"
 4. 1011 "Performance Requirements for Hose Connection Vacuum Breakers"
 5. 1012 "Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent"
 6. 1013 "Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers"
 7. 1015 "Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies"
 8. 1017 "Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems"
 9. 1018 "Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied"
 10. 1019 "Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type"
 11. 1020 "Performance Requirements for Pressure Vacuum Breaker Assembly"
- C. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
 1. A48 "Standard Specification for Gray Iron Castings"
 2. A74 "Standard Specification for Cast Iron Soil Pipe and Fittings"
 3. B62 "Standard Specification for Composition Bronze or Ounce Metal Castings"
 4. C564 "Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings"
- D. American Water Works Association (AWWA) Publications:
 1. C550 "Standard for Protective Interior Coatings for Valves and Hydrants"
- E. Food and Drug Administration (FDA) Publications:
- F. National Fire Protection Association (NFPA) Publications:
 1. 70 "National Electric Code"
- G. Plumbing & Drainage Institute (PDA) Publications:
 1. G101 "Testing and Rating Procedure for Grease Interceptors"
 2. WH 201 "Water Hammer Arresters Standard"
- H. Underwriter's Laboratories, Inc. (UL) Standards:
 1. 486A "Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors"
 2. 486B "Standard for Wire Connectors for Use With Aluminum Conductors"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 - 1. Product Data: For each plumbing specialty indicated. Include rated capacities of selected equipment and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following plumbing specialty products:
 - a. Backflow preventers.
 - b. Water regulators.
 - c. Thermostatic mixing valves and water tempering valves.
 - d. Water hammer arresters.
 - e. Trap primer valves.
 - f. Drain valves.
 - g. Hydrants.
 - h. Clothes washer drain & supply.
 - i. Backwater valves.
 - j. Cleanouts.
 - k. Floor drains, open receptors, and trench drains.
 - l. Vent caps, vent terminals, and roof flashing assemblies.
 - m. Roof drains.
 - n. Lint traps.
 - 2. Reports: Specified in "Field Quality Control" Article.
 - 3. Maintenance Data: For specialties to include in the maintenance manuals specified in Division 01.

1.04 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on plumbing specialties made to specified standards.
- B. Listing and Labeling: Provide electrically operated plumbing specialties specified in this Section that are listed and labeled.
 - 1. Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.
- C. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- D. Comply with NFPA 70, "National Electrical Code," for electrical components.

1.05 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described in Section 01 78 43 (01790) - "Spare Parts and materials" below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers:

1. Backflow Preventers:
 - a. Watts Water Technologies, Inc.
 - b. Zurn Industries, Inc.; Wilkins Div.
2. Water Regulators:
 - a. Conbraco Industries, Inc.
 - b. Watts Water Technologies, Inc.
 - c. Zurn Industries, Inc.; Wilkins Div.
3. Thermostatic Water Mixing Valves:
 - a. Lawler Manufacturing Co., Inc.
 - b. Leonard Valve Co.
 - c. Symmons Industries, Inc.
4. Clothes Washer Drain & Supply
 - a. Acorn Engineering Co.
 - b. Guy Gray Manufacturing Co., Inc., IPS Corporation
 - c. Symmons Industries, Inc.
5. Hydrants:
 - a. Jay R. Smith Mfg. Co., Division of Smith Industries
 - b. Woodford Manufacturing Co.
 - c. Zurn Industries, Inc.;
6. Water Hammer Arresters:
 - a. Precision Plumbing Products, Inc.
 - b. Sioux Chief Manufacturing Co., Inc.
 - c. Jay R. Smith Mfg. Co., Division of Smith Industries
7. Trap Primer Valves:
 - a. Precision Plumbing Products, Inc.
 - b. Jay R. Smith Mfg. Co., Division of Smith Industries
 - c. Watts Water Technologies, Inc.
 - d. Zurn Industries, Inc.
8. Backwater Valves:
 - a. Jay R. Smith Mfg. Co., Division of Smith Industries
 - b. Watts Water Technologies, Inc.
 - c. Zurn Industries, Inc.;

9. Floor Drains
 - a. Jay R. Smith Mfg. Co., Division of Smith Industries
 - b. Josam Co.
 - c. Zurn Industries, Inc.
10. Roof Drains
 - a. Jay R. Smith Mfg. Co., Division of Smith Industries
 - b. Josam Co.
 - c. Zurn Industries, Inc.
11. Grease Interceptors
 - a. Jay R. Smith Mfg. Co., Division of Smith Industries
 - b. Josam Co.
 - c. Zurn Industries, Inc.
12. Lint Interceptors
 - a. Jay R. Smith Mfg. Co., Division of Smith Industries
 - b. Josam Co.
 - c. Zurn Industries, Inc.

2.02 BACKFLOW PREVENTERS

- A. General: ASSE standard, backflow preventers, of size indicated for maximum flow rate and maximum pressure loss indicated.
 1. Body: Bronze, with flanged ends.
 2. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.
 3. Interior Components: Corrosion-resistant materials.
 4. Exterior Finish: Rough Brass.
 5. Strainer on inlet.
 6. Test Kit with Plastic Case: Per manufacturer's recommendation.
- B. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.
- C. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7 garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
- D. Intermediate Atmospheric-Vent Backflow Preventers: ASSE 1012, suitable for continuous pressure application. Include inlet screen and 2 independent check valves with intermediate atmospheric vent.
- E. Reduced-Pressure-Principle Backflow Preventers: ASSE 1013, suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet; test cocks; and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between 2 positive-seating check valves.

1. Pressure Loss: 12 psig maximum, through middle one-third of flow range.
- F. Double-Check Backflow Prevention Assemblies: ASSE 1015, suitable for continuous pressure application. Include shutoff valves on inlet and outlet, and strainer on inlet; and test cocks with 2 positive-seating check valves.
 1. Pressure Loss: 5 psig maximum, through middle one-third of flow range.
- G. Antisiphon-Pressure-Type Vacuum Breakers: ASSE 1020, suitable for continuous pressure application. Include shutoff valves, spring-loaded check valve, spring-loaded floating disc, test cocks, and atmospheric vent.
 1. Pressure Loss: 5 psig maximum, through middle one-third of flow range.

2.03 WATER REGULATORS

- A. General: ASSE 1003, water regulators, rated for initial working pressure of 150 psig minimum, of size, flow rate, and inlet and outlet pressures indicated. Include integral factory-installed or separate field-installed Y-pattern strainer.
 1. 2-Inch NPS (DN50) and Smaller: Bronze body with threaded ends.
 2. 2-1/2-Inch NPS (DN65) and Larger: Bronze or cast-iron body with flanged ends. Include AWWA C550 or FDA-approved interior epoxy coating for regulators with cast-iron body.
 3. Interior Components: Corrosion-resistant materials.
 4. Exterior Finish: Standard
 5. Single-seated, direct-operated type.
- B. Pilot-operated type, single- or double-seated, cast-iron-body main valve, with bronze-body pilot valve.

2.04 THERMOSTATIC MIXING VALVES

- A. General: ASSE 1017, manually adjustable, thermostatic water mixing valve with bronze body. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and capacity at pressure loss as indicated.
 1. Bimetal Thermostat, Operation and Pressure Rating: 125 psig minimum.
- B. Thermostatic Water Mixing Valves: Unit, with the following:
 1. Piping, of sizes and in arrangement indicated. Include valves and unions.
 2. Piping Component Finish: Rough brass.
 3. Thermometer: Manufacturer's standard.

2.05 CLOTHES WASHER DRAIN & SUPPLY

- A. General: Recessed-mounting outlet boxes with fittings complying with ASME A112.18.1. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.
- B. Clothes Washer Outlet Boxes: With hose connections, drain, and the following:
 1. Box and Faceplate: Plastic.
 2. Shutoff Fittings: 2 hose bibbs.

3. Supply Fittings: Two 1/2-inch NPS (DN15) gate, globe, or ball valves and 1/2-inch NPS (DN15) copper, water tubing.
4. Drain Fitting: 2-inch NPS (DN50) drainage piping P-trap with 2-inch NPS (DN50) standpipe extending from floor to outlet box and 2-inch NPS (DN50) waste.

2.06 HYDRANTS

- A. Wall Hydrants: ASME A112.21.3M, nonfreeze, key operation. Provide one operating key.
 1. Inlet: 3/4- or 1-inch NPS (DN20 or DN25) threaded or solder joint.
 2. Outlet: ASME B1.20.7 garden-hose threads, and integral or field-installed, nonremovable, drainable, hose-connection vacuum breaker with ASME B1.20.7 garden-hose threads on outlet.
 3. Type: Projecting.
 4. Finish: Nickel bronze.
- B. Wall Hydrants: ASME A112.21.3M or ASSE 1019, nonfreeze, automatic draining, anti-back flow type, key operation, with 3/4- or 1-inch NPS (DN20 or DN25) threaded or solder-joint inlet, and ASME B1.20.7 garden-hose threads on outlet. Include operating key for each hydrant.
 1. Type: Recessed
 2. Finish: Nickel bronze.
- C. Wall Hydrants: ASME A112.21.3M, projecting, automatic draining, antbackflow type, key operation. Include operating key for each hydrant.
 1. Inlet: 3/4- or 1-inch NPS (DN20 or DN25) threaded or solder joint.
 2. Outlet: ASME B1.20.7 garden-hose threads.
 3. Finish: Nickel bronze.

2.07 TRAP PRIMER VALVES

- A. Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
 1. 125-psig minimum working pressure.
 2. Bronze body with atmospheric-vented drain chamber.
 3. Inlet and Outlet Connections: 1/2-inch NPS (DN15) threaded, union, or solder joint.
 4. Gravity Drain Outlet Connection: 1/2-inch NPS (DN15) threaded or solder joint.
 5. Finished: Rough bronze.

2.08 DRAIN VALVES

- A. Hose-End Drain Valves: MSS SP-110, 3/4-inch NPS (DN20) ball valve, rated for 400-psig minimum CWP. Include 2-piece, ASTM B62 bronze body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.
 1. Inlet: Threaded or solder joint.
 2. Outlet: Short-threaded nipple with ASME B1.20.7 garden-hose thread and cap.

3. Hose-End Drain Valve Option: MSS SP-80, gate valve, Class 125, ASTM B62 body, with 3/4-inch NPS (DN20) threaded or solder-joint inlet and ASME B1.20.7 garden-hose threads on outlet and cap. Hose bibbs are prohibited for this application.
- B. Stop-and-Waste Drain Valves: MSS SP-110, ball valve, rated for 200-psig minimum CWP or MSS SP-80, Class 125, gate valve; ASTM B62 bronze body, with 1/8-inch NPS (DN6) side drain outlet and cap.

2.09 BACKWATER VALVES

- A. Horizontal Backwater Valves: ASME A112.14.1, cast-iron body, with removable bronze swing-check valve and threaded or bolted cover.
 1. Closed-Position Check Valve: Factory assembled or field modified to hang closed unless subject to backflow condition.
 2. Open-Position Check Valve: Factory assembled or field modified to hang open unless subject to backflow condition.
 3. Extension: ASTM A74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor, instead of cover.
- B. Drain Outlet Backwater Valves: Cast-iron or bronze body, with removable ball float, threaded inlet, and threaded or spigot outlet.

2.10 FLOOR DRAINS

- A. Floor Drains:
 1. Comply with ASME A112.21.1M and ASME A112.3.1.
 2. Refer to Plumbing Fixture Matrix

2.11 ROOF DRAINS

- A. Roof Drains:
 1. Comply with ASME A112.21.2M and ASME A112.3.1.
 2. Refer to Plumbing Fixture Matrix
 3. Extension Collars: [Required].
 4. Underdeck Clamp: [Required]
 5. Sump Receiver: Required.

2.12 GREASE INTERCEPTORS:

- A. Comply with PDI-G101.
- B. Plumbing and Drainage Institute Seal: Required.
- C. Body Material: [Cast iron or steel].
- D. Body Extension: [Required].
- E. Flow Rate: Per Schedules
- F. Grease Retention Capacity: Per Schedules.
- G. Inlet and Outlet Size: Per Schedules.
- H. Cleanout: Integral
 1. Mounting: Refer to plans & Schedules.

2. Operation: Manual Cleaning.

2.13 LINT INTERCEPTORS

- A. Body Material: Cast iron or steel.
- B. Interior Separation Device: Baffels.
- C. Flow Rate: Per Schedules
- D. Inlet and Outlet Size: Per Schedules.
- E. Mounting: Inline.

2.14 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010, or PDI-WH 201, bellows or piston type with pressurized cushioning chamber. Sizes are based on water-supply fixture units.
- B. Interior Hose Bibbs: Bronze body, with renewable composition disc, 1/2- or 3/4-inch NPS (DN15 or DN20) threaded or solder-joint inlet. Provide ASME B1.20.7 garden-hose threads on outlet and integral or field-installed, nonremovable, drainable, hose-connection vacuum breaker.
 - 1. Finish: Rough brass.
 - 2. Operation: Wheel handle.
- C. Roof Flashing Assemblies: Coordinate with Division 07 Sections for roofing systems.
- D. Open Drains: 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 of length to provide depth indicated; and where indicated, increaser fitting of size indicated, joined with ASTM C564 rubber gaskets. Size P-trap as indicated.
- E. Deep-Seal Traps: Cast iron or bronze, with inlet and outlet matching connected piping, cleanout where indicated, and trap seal primer valve connection where indicated.
 - 1. 2-Inch NPS (DN50): 4-inch minimum water seal.
 - 2. 2-1/2 Inch NPS (DN65) and Larger: 5-inch minimum water seal.
- F. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
- G. Air-Gap Fittings: ASME A112.1.2, cast iron or cast bronze, with fixed air gap, inlet for drain pipe or tube, and threaded or spigot outlet.
- H. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- I. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- J. Vent Terminals: Commercially manufactured, shop-fabricated or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counter flashing, as indicated.
- K. Expansion Joints: ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing, of size and end types corresponding to connected piping.

PART 3 EXECUTION

3.01 PLUMBING SPECIALTY INSTALLATION

A. General:

1. Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.
2. Install expansion joints on vertical risers, stacks, and conductors as indicated.
3. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
4. Fasten recessed, wall-mounting plumbing specialties to reinforcement built into walls.
5. Secure supplies to supports or substrate.
6. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
7. Locate drainage piping as close as possible to bottom of floor slab supporting fixtures and drains.
8. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
9. Include wood-blocking reinforcement for recessed and wall-mounting plumbing specialties.

B. Backflow Preventers:

1. Install backflow preventers of type, size, and capacity indicated, at each water-supply connection to mechanical equipment and systems, and to other equipment and water systems as indicated. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment. Install air-gap fitting on units with atmospheric-vent connection and pipe relief outlet drain to nearest floor drain. Do not install bypass around backflow preventer.

C. Pressure Regulators:

1. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet. Refer to Section 22 05 19 - "Meters and Gauges for Plumbing Piping".

D. Hose Bibbs:

1. Install hose bibbs with integral or field-installed vacuum breaker.

E. Wall Hydrants:

1. Install wall hydrants with integral or field-installed vacuum breaker.

F. Valves:

1. Install trap seal primer valves in accessible locations with valve outlet piping pitched down toward drain trap a minimum of one percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow. Identify device locations on record drawings.

2. Install backwater valves in building drain piping as indicated. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
3. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated.
4. Install water-supply stop valves in accessible locations.

G. Cleanouts:

1. Install cleanouts in aboveground piping and building drain piping as indicated, and where not indicated, according to the following:
 - a. Size same as drainage piping up to 4-inch NPS (DN100). Use 4-inch NPS (DN100) for larger drainage piping unless larger cleanout is indicated.
 - b. Locate at each change in direction of piping greater than 45 degrees.
 - c. Locate at minimum intervals of 50 feet for piping 4-inch NPS (DN100) and smaller and 100 feet for larger piping.
 - d. Locate at base of each vertical soil and waste stack.
2. Install cleanout deck plates, of types indicated, with top flush with finished floor, for floor cleanouts for piping below floors.
3. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed walls.

H. Flashings and Vent Caps

1. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
2. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
3. Install frost-proof vent caps on each vent pipe passing through roof (where required). Maintain 1-inch clearance between vent pipe and roof substrate.

I. Floor Drains:

1. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor or as indicated. Size outlets as indicated.
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 one percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
3. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
4. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

5. Position floor drains for easy access and maintenance.

J. Roof Drains:

1. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Size outlets as indicated.
2. Install roof-drain flashing collar or flange so no leakage occurs between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
3. Position roof drains for easy access and maintenance.

K. Interceptors

1. Install interceptors, including trapping, venting, and flow control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - a. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 - b. Flush with Floor Installation: Set unit and extension if required, with cover flush with finished floor.
 - c. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 - d. Install clean out immediately downstream from interceptors not having integral cleanout on outlet.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
1. Install piping connections between plumbing specialties and piping specified in other Division 22 Sections.
 2. Install piping connections indicated between appliances and equipment specified in other Sections; connect directly to plumbing piping systems.
 3. Install piping connections indicated as indirect wastes from appliances and equipment specified in other Sections, to spill over receptors connected to plumbing piping systems.
- B. Install hoses between plumbing specialties and appliances as required for connections.
- C. Arrange for electric-power connections to plumbing specialties and devices that require power. Electric power is specified in Division 26 Sections.
- D. Supply Runouts to Plumbing Specialties: Install hot- and cold-water-supply piping of sizes indicated, but not smaller than required by authorities having jurisdiction.
- E. Drainage Runouts to Plumbing Specialties: Install drainage and vent piping, with approved trap, of sizes indicated, but not smaller than required by authorities having jurisdiction.
- F. Interceptor Connections: Connect piping, flow-control fittings, and accessories as indicated.
1. Grease Interceptors: Connect inlet and outlet to unit, and flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- G. Ground electric-powered plumbing specialties.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 FLASHING INSTALLATION

- A. Fabricate flashing manufactured from single piece unless large pans, sumps, or other drainage shapes are required.
- B. Burn joints of lead sheets where required.
- C. Solder joints of copper sheets where required.
- D. 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.
- E. Set flashing on floors and roofs in solid coating of bituminous cement.
- F. Secure flashing into sleeve and specialty clamping ring or device.
- G. Install flashing for piping passing through roofs with counter flashing or commercially made flashing fittings, according to Division 07 Sections for type of roofing.
- H. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- I. Fabricate and install flashing and pans, sumps, and other drainage shapes as indicated. Install drain connection if indicated.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of factory-authorized service representative to supervise the field assembly of components and installation of grease recovery units, including piping and electrical connections, and to report results in writing.
 1. Test and adjust plumbing specialty controls and safeties. Replace damaged and malfunctioning controls and components.

3.05 COMMISSIONING

- A. Before startup, perform the following checks:
 1. System tests are complete.
 2. Damaged and defective specialties and accessories have been replaced or repaired.
 3. Clear space is provided for servicing specialties.
- B. Before operating systems, perform the following steps:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open general-duty valves to fully open position.
 3. Remove and clean strainers.

4. Verify that drainage and vent piping are clear of obstructions. Flush with water until clear.
 - C. Startup Procedures: Follow manufacturer's written instructions.
 - D. Adjust operation and correct deficiencies discovered during commissioning.
- 3.06 DEMONSTRATION
- A. Startup Services: Engage a factory-authorized service representative to perform startup services and train Owner's maintenance personnel as specified below:
 1. Train Owner's maintenance personnel on procedures and schedules related to startup of and servicing interceptors.
 2. Train Owner's maintenance personnel on procedures and schedules related to startup of and servicing grease recovery units.
- 3.07 PROTECTION
- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
 - B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 34 00 - FUEL-FIRED, DOMESTIC WATER HEATERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Gas fired water heaters.
2. Storage tanks.
3. Expansion tanks.
4. Accessories.

B. Related Sections:

1. Section 03 30 00 - Cast-in-Place Concrete
2. Section 22 05 00 – Common Work Results for Plumbing
3. Section 22 05 23– General Duty Valves for Plumbing Piping
4. Section 22 05 19 - Meters and Gages for Plumbing Piping
5. Section 22 11 23– Domestic Water Pumps
6. Section 22 30 00 - Plumbing Equipment

1.02 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. Z21.10.3 “Gas Water Heaters - Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous”
1. [Z21.12] [a. “Addenda 1 to ANSI Z21.12-1990, Draft Hoods”] [“b. Addenda 2 to ANSI Z21.12-1990 and ANSI Z21.12A-1993, Draft Hoods”] 22_34_00, 2.2G, 2.3G
2. Z21.13 “Gas-Fired Low Pressure Steam and Hot Water Boilers”
3. Z21.15 “Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves”
4. Z21.18 “Gas Appliance Pressure Regulators”
5. Z21.20 “Automatic Gas Ignition Systems and Components”
6. Z21.21 “Automatic Valves for Gas Appliances (same as CSA 6.5)”
7. Z21.22 “Relief Valves for Hot Water Supply Systems”

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Publications:

1. 90.1 “Energy Code for Commercial and High-Rise Residential Buildings”
2. 90.2 “Energy Code for New Low-Rise Residential Buildings”

C. The American Society of Mechanical Engineers (ASME) Publications:

1. “(The 2004) ASME Boiler and Pressure Vessel Code”
2. B1.20.1 "Pipe Threads, General Purpose, Inch"
3. B16.5 “Pipe Flanges and Flanged Fittings: NPS 1/2 through 24”

4. B16.24 "Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500 and 2500"
- D. American Society of Sanitary Engineering (ASSE) Publications:
 1. 1017 "Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems"
- E. Canadian Standards Association (CSA) Publications:
 1. B125.1 "Plumbing Supply Fittings"
- F. National Fire Protection Association (NFPA) Publications:
 1. 54 "National Fuel Gas Code"
 2. 70 "National Electric Code"
- G. Underwriter's Laboratories, Inc. (UL) Publications:
 1. 486A "Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors"
 2. 486B "Standard for Wire Connectors for Use With Aluminum Conductors"
 3. 778 "Standard for Motor-Operated Water Pumps"
 4. 795 "Standard for Commercial-Industrial Gas Heating Equipment"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 1. Product Data:
 - a. For each type and size of water heater, include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
 - b. Wiring Diagrams: Power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring.
 2. Product Certificates: Signed by manufacturers of water heaters certifying that products furnished comply with requirements.
 3. Maintenance Data: For water heaters to include in maintenance manuals specified in Division 01.
 4. Warranties: Special warranties specified in this Section.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on specific units indicated.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. ANSI Compliance: Provide gas water heaters that comply with ANSI standards for gas water heaters and related products and that bear AGA certification label.

- E. ASME Compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 01.
- F. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
 - 1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.

1.05 WARRANTY

- A. General Warranty: Special warranty 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. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include storage tanks, circulators, and burner assemblies.
 - 2. Warranty Period: From date of Substantial Completion:
 - a. Storage Tanks: Five (5) years.
 - b. Circulators and Burner Assemblies: One (1) Year.
 - c. Tank Type Water Heaters: Three (3) Year Leakage, One (1) Year Parts.
 - d. Boilers: Five (5) Year Leakage, One (1) Year Parts.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers
 - 1. Gas Fired Water Heaters:
 - a. Lochinvar Corporation.
 - b. A. O. Smith Water Products Co.
 - c. Raypak, Inc
 - d. RBI Water Heaters
 - 2. Expansion Tanks:
 - a. Amtrol, Inc. (401-884-6300)
 - b. A. O. Smith Water Products Co. (800-527-1953)
 - c. Wessels Company. (317-888-9800)
 - d. Taco, Inc. (401-942-8000)

2.02 GAS FIRED WATER HEATERS

- A. Description: Comply with ANSI Z21.10.3.
- B. Storage Tank Construction: ASME -code steel with 160-psig working-pressure rating.
 - 1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.

- a. NPS 2 (DN50) and Smaller: Threaded ends according to ASME B1.20.1, pipe threads.
- b. NPS 2-1/2 (DN65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
- 2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
- 3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
- 4. Jacket: Steel, with enameled finish.
- C. Burner: For use with [atmospheric] [automatic] [powered] vent water heaters for natural-gas fuel.
 - 1. Temperature Control: Adjustable thermostat.
 - 2. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - 3. Automatic Ignition: ANSI Z21.20, automatic gas-ignition system and components.
- D. Anode Rods: Factory installed, magnesium.
- E. Dip Tube: Factory installed. Not required if cold-water inlet is near bottom of storage tank.
- F. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
- G. Draft Control: [Draft diverter; comply with ANSI Z21.12] [Powered-vent system].

2.03 EXPANSION TANKS

- A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
- B. Construction: 150-psig working-pressure rating.
- C. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
- D. Tank Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
- E. Tank Exterior Finish: Manufacturer's standard, unless finish is indicated.
- F. Air-Charging Valve: Factory installed.

2.04 WATER HEATER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: According to the following:
 - 1. Gas Water Heaters: ANSI Z21.22, combination temperature and pressure relief valve.
 - 2. Option: Separate temperature and pressure relief valves are acceptable instead of combination relief valve.
- B. Pressure Relief Valves: According to the following:
 - 1. Gas Water Heaters: ANSI Z21.22 pressure relief valve for storage tanks of 200,000 Btuh (58.6 kW).
- C. Vacuum Relief Valves: According to the following:

1. Gas Water Heaters: ANSI Z21.22.
2. Exception: Omit if water heater has integral vacuum-relieving device.
- D. Gas Shutoff Valves: ANSI Z21.15, manually operated. Furnish for installation in piping.
- E. Gas Pressure Regulators: ANSI Z21.18, appliance type, factory or field installed. Include pressure rating, capacity, and pressure differential required for water heater and gas supply.
- F. Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
- G. Digital recirculation valve, ASSE 1017 & CSA B125.3-12, appliance, electronically operated mixing valve.
- H. Water Heater Stands: Water heater manufacturer's factory-fabricated, steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.
- I. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4 (DN20).
- J. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.
- K. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE 90.1 or ASHRAE 90.2.

PART 3 EXECUTION

3.01 CONCRETE BASES

- A. Install concrete bases of dimensions indicated. Refer to Section 03 30 00 "Cast-in-Place Concrete" and Section 22 05 00 - "Common Work Results for Plumbing."

3.02 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
- B. Install water heaters, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Anchor water heaters to substrate.
- D. Where required, install seismic restraints for water heaters. Anchor to substrate.
- E. Install and connect gas water heaters according to NFPA 54.
 1. Install appliance, gas pressure regulators on gas-burner inlets of water heaters without pressure regulators.
 2. Install vent piping from gas-train pressure regulators and valves to outside of building where required. Terminate vent piping with brass-screened vent cap fitting. Do not combine vents except with approval of authorities having jurisdiction.
- F. Install temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.

- G. Install pressure relief valves in water piping for water heaters without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.
- H. Install vacuum relief valves in cold-water-inlet piping.
- I. Install vacuum relief valves in water heater storage tanks that have copper lining.
- J. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Section 22 10 13 - "Plumbing Specialties" for drain valves.
- K. Install thermometers on water heater inlet and outlet piping. Refer to Section 22 05 19 - "Meters and Gages for Plumbing Piping" for thermometers.
- L. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Section 22 05 23 - "General Duty Valves for Plumbing Piping" for general-duty valves and Section 22 05 19 "Meters and Gages for Plumbing Piping" for thermometers.
- M. Arrange for insulation on equipment and piping not furnished with factory-applied insulation.
- N. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- O. Fill water heaters with water.
- P. Charge expansion tanks with air as required by manufacturer.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect hot- and cold-water piping with shutoff valves and unions. Connect hot-water-circulating piping with shutoff valve, check valve, and union.
- D. Connect gas piping to gas burner with drip leg, tee, shutoff valve, and union; minimum size same as inlet connection.
- E. Make connections with dielectric fittings where piping is made of dissimilar metal.
- F. Gas, Water Heater Vent Connections: Connect to vent system. Include draft hoods and diverters where required. Use vents same size as or larger than water heater outlets, but not smaller than indicated unless smaller vent size has been calculated according to NFPA 54. Comply with gas utility requirements for sizing. Gas vents are specified in Section 22 51 00 "Breechings, Chimneys, and Stacks." Provide ducted combustion air.
- G. Electrical Connections: Power wiring and disconnect switches are specified in Division 26 Sections. Arrange wiring to allow unit service.
- H. Ground equipment.
 - 1. 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 and UL 486B.

3.04 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to perform startup service.
- B. In addition to manufacturer's written installation and startup checks, perform the following:
 - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment and retest until satisfactory results are achieved.
 - 2. Verify that piping system tests are complete.
 - 3. Check for piping connection leaks.
 - 4. Check for clear relief valve inlets, outlets, and drain piping.
 - 5. Check operation of circulators.
 - 6. Test operation of safety controls, relief valves, and devices.
 - 7. Energize electric circuits.
 - 8. Adjust operating controls.
 - 9. Adjust hot-water-outlet temperature settings. Do not set above 140 deg F unless piping system application requires higher temperature.
 - 10. Balance water flow through manifolds of multiple-unit installations.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.
 - 1. Conduct training as specified in Section 01 79 00 "Training".
 - 2. Train Owner's maintenance personnel on procedures for starting and stopping troubleshooting, servicing, and maintaining equipment.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plumbing Fixture Standards
2. Miscellaneous Fixture Standards
3. Miscellaneous Component Standards

B. Related Sections:

1. Section 07 92 00 - Joint Sealant: For sealing between fixtures and walls, floors, and counters.
2. Section 22 05 00 – Common Work Results for Plumbing
3. Section 22 05 23 – General Duty Valves for Plumbing Piping
4. Section 22 30 00 - Plumbing Equipment

1.02 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. A117.1 “Accessible and Useable Buildings and Facilities”
2. Z124.1 “Plastic Bathtub Units”
3. Z124.1a, and Z124.1b
4. Z124.5 “Plastic Toilet (Water Closet) Seats”
5. Z124.6 “Plastic Sinks”
6. Z358.1 “Emergency Eyewash and Shower Equipment”

B. Air-Conditioning and Refrigeration Institute (ARI) Publications:

1. 1010 “Self-Contained, Mechanically Refrigerated Drinking-Water Coolers”

C. The American Society of Mechanical Engineers (ASME) Publications:

1. A112.6.1.M “Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use”
2. A112.18.1 “Plumbing Fixture Fittings”
3. A112.19.2 “Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals”
4. A112.19.3 “Stainless Steel Fixtures (Designed for Residential Use)”
5. A112.19.4M “Porcelain Enameled Formed Steel Plumbing Fixtures”
6. A112.19.5 “Trim for Water-Closet Bowls, Tanks and Urinals”
7. A112.19.8M “Suction Fittings for Swimming & Wading Pools Spas Hot Tubs & Whirlpool Bathtub Appliances”
8. A112.21.1M “Floor Drains”
9. B1.20.1 "Pipe Threads, General Purpose, Inch"

10. B1.20.7 "Hose Coupling Screw Threads, Inch"

D. American Society of Sanitary Engineering (ASSE) Publications:

1. 1001 "Performance Requirements for Atmospheric Type Vacuum Breakers"
2. 1008 "Performance Requirements for Household Food Waste Disposer Units"
3. 1011 "Performance Requirements for Hose Connection Vacuum Breakers"
4. 1014 "Performance Requirements for Backflow Prevention Devices for Hand-Held Showers"
5. 1016 "Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations"
6. 1025 "Performance Requirements for Diverters for Plumbing Faucets with Hose Spray, Anti-Siphon Type, Residential Applications"
7. 1037 "Performance Requirements for Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures"

E. ASTM International (ASTM) Publications:

1. F444 "Standard Consumer Safety Specification for Scald-Preventing Devices and Systems in Bathing Areas"
2. F445 "Consumer Safety Specification for Thermal-Shock-Preventing Devices and Systems in Showering Areas"
3. F462 "Consumer Safety Specification for Slip-Resistant Bathing Facilities"

F. National Sanitation Foundation Construction (NSF) Publications:

1. 2 "Food Equipment"
2. 61 "Drinking Water System Components - Health Effects"

G. Underwriter's Laboratories, Inc. (UL) Publications:

1. 399 "Drinking Water Coolers"
2. 430 "Waste Disposers"
3. 486A "Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors"
4. 486B "Standard for Wire Connectors for Use With Aluminum Conductors"

1.03 DEFINITIONS

- A. Accessible: Plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped, disabled, and elderly people.
- B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, traps and waste pipes. Pipe fittings, tube fittings, and general-duty valves are included where indicated.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data for each plumbing fixture category and type specified. Include selected fixture, trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category from one source and by a single manufacturer.
 1. Exception: Where fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for this category.
- B. Regulatory Requirements: Comply with requirements of CABO A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; regarding plumbing fixtures for physically handicapped people.
- C. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- D. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver plumbing fixtures in manufacturer's protective packing, crating, and covering.
- B. Store plumbing fixtures on elevated platforms in dry location.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Coordinate roughing-in and final fixture locations and verify that plumbing fixtures can be installed to comply with original design and referenced standards.

1.08 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described in Section 01 78 43 - "Spare Parts and Maintenance" that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. See Plumbing Fixture Schedule for list of which Manufacturer's are approved for use on a specific item.
- B. Approved Manufacturers:
 1. American Standard, Inc.
 - a. Bathtubs
 - b. Bathtub Drains
 - c. Bath/Shower Diverters, Valves & Trim
 - d. Faucets
 - e. Vanity Sinks
 - f. Laundry Sinks
 - g. Service Sinks

- h. Sink Strainers
 - i. Toilet Seats
 - j. Urinals
 - k. Water Closets
- 2. Church Seats, A Division of Bemis Manufacturing Company
 - a. Toilet Seats
- 3. Delta Faucet Company
 - a. Bath/Shower Diverters, Valves & Trim
 - b. Faucets
 - c. Mop Hangers/Hose Holders/
 - d. Sink Strainers
- 4. Elkay Manufacturing Co.
 - a. Sinks
 - b. Water Coolers
- 5. Halsey Taylor
 - a. Water Coolers
- 6. Haws Corp.
 - a. Eye Wash
 - b. Water Coolers
- 7. Jay R. Smith Mfg. Co.
 - a. Floor Drains
 - b. Floor Sinks
 - c. Cleanouts
 - d. Lint Interceptor
 - e. Roof Drains
 - f. Yard Hydrants
 - g. Wall Hydrants
- 8. Josam Co.
 - a. Floor Drains
 - b. Floor Sinks
 - c. Cleanouts
 - d. Lint Interceptor
 - e. Roof Drains
 - f. Yard Hydrants
 - g. Wall Hydrants

9. Kohler Co.
 - a. Bathtubs
 - b. Bathtub Drains
 - c. Bath/Shower Diverters, Valves & Trim
 - d. Faucets
 - e. Laundry Sinks
 - f. Service Sinks
 - g. Shower Heads
 - h. Sinks
 - i. Sink Strainers/Grid Strainers
 - j. Toilet Seats
 - k. Urinals
 - l. Water Closets
10. McGuire Manufacturing Company, Inc.
 - a. Bathtub Drains
11. Mincey Marble Manufacturing Co.
 - a. Shower Base
12. Moen Incorporated
 - a. Bath/Shower Diverters, Valves & Trim
 - b. Faucets
 - c. Mop Hangers/Hose Holders/
 - d. Sink Strainers
13. MPL Corporation
 - a. Shower Base
14. E. L. Mustee & Sons, Inc.
 - a. Mop Sink
 - b. Mop Hanger/Hose Holder/Wall Guard
 - c. Laundry Sink / Faucet
15. Oasis Industries Inc.
 - a. Water Coolers
16. Oatey SCS
 - a. Shower Drains
17. Speakman Company
 - a. Shower Heads
18. Symmons Industries, Inc.

- a. Bath/Shower Diverters, Valves & Trim
- b. Faucets
- 19. Toto USA, Inc.
 - a. Toilet Seats
 - b. Water Closets
- 20. Provent Systems, Inc.
 - a. Proset Trap Guard Floor Drain Inserts
- 21. Zurn Industries, Inc.
 - a. Floor Drains
 - b. Floor Sinks
 - c. Cleanouts
 - d. Lint Interceptor
 - e. Roof Drains
 - f. Yard Hydrants
 - g. Wall Hydrants

2.02 PLUMBING FIXTURE STANDARDS

- A. Comply with applicable standards below and other requirements specified.
 - 1. Electric Water Coolers: AHRI 1010 and UL 399.
 - 2. Emergency Equipment: ANSI Z358.1.
 - 3. National Sanitation Foundation Construction: NSF 2 and NSF 61.
 - 4. Bathtubs: ANSI Z124.1, ANSI Z124.1a, and ANSI Z124.1b.
 - 5. Plastic Laundry Trays: ANSI Z124.6.
 - 6. Plastic Mop-Service Basins: ANSI Z124.6.
 - 7. Shower Enclosures: ANSI Z124.2 and ANSI Z124.2a.
 - 8. Shower Bases: Cast Polymer ANSI Z124.1.3
 - 9. Porcelain-Enameled Fixtures: ASME A112.19.4M.
 - 10. Slip-Resistant Bathing Surfaces: ASTM F462.
 - 11. Stainless-Steel Fixtures Other than Service Sinks: ASME A112.19.3M.
 - 12. Vitreous-China Fixtures: ASME A112.19.2M.
 - 13. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 14. Water-Closet, Flushometer Tank Trim: ASSE 1037.

2.03 LAVATORY/SINK FAUCET STANDARDS

- A. Comply with ASME A112.18.1, NSF 61 and other requirements specified for lavatory, sink, and similar-type-fixture faucet fittings. Include hot- and cold-water indicators; 2.5-gpm-maximum flow rate; and finish as shown on Plumbing Fixture Matrix on metal body. Coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
1. Faucet:
 - a. Valve shall be ceramic discs in cartridge assembly.
 - b. Handles as indicated.
 - c. Pop-up or grid drain as indicated.
 2. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 3. Faucet Hose: ASTM D3901.
 4. Hose-Connection Vacuum Breakers: ASSE 1011.
 5. Hose-Coupling Threads: ASME B1.20.7.
 6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 7. Pipe Threads: ASME B1.20.1.
 8. Sink Spray Hoses: ASTM D3573.
 9. Accessible Lavatory Trap Insulation Kit: ADA 610.5.

2.04 BATHTUB/SHOWER FAUCET STANDARDS

- A. Comply with ASME A112.18.1 and other requirements specified for bathtub and shower faucet fittings. Include hot- and cold-water indicators; 2.5-gpm-maximum flow rate; and finish as shown on Plumbing Fixture Schedule. Coordinate faucet inlets with supplies and outlet with diverter valve; tub spout; and shower head, arm, and flange.
1. All Trim to be metallic.
 2. Valving shall be ceramic discs in cartridge assemblies.
 3. Cast brass valve-body with integral cast-in service stops.
 4. Pressure balancing faucets shall utilize a diaphragm-balancing cartridge with integral check valves.
 5. Combination, Pressure-Equalizing- and Thermostatic-Control, Antiscald Faucets: ASSE 1016.
 6. Pressure balancing faucets shall utilize a diaphragm-balancing cartridge with integral check valves.
 7. Hand-Held Showers: ASSE 1014.
 8. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F445.
 9. Hose-Coupling Threads: ASME B1.20.1 or ASME B1.20.7.
 10. Manual-Control Antiscald Faucets: ASTM F444.
 11. Pipe Threads: ASME B1.20.1.
 12. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

13. Thermostatic-Control Antiscald Faucets: ASTM F444 and ASSE 1016.

2.05 SHOWER BASE STANDARDS

- A. Cast Polymer Shower Bases shall comply with ANSI Z124.1.2. Types shall be standard and wheelchair accessible sizes and shapes as shown on Drawings. Color as shown on Plumbing Fixture Schedule. Provide drain of size indicated with NPS 2 outlet. Floor shall have textured non-slip surface per ASTM 1028 and ASTM F462.

2.06 MISCELLANEOUS FITTING STANDARDS

- A. Comply with ASME A112.18.1 and other requirements specified for fittings, other than faucets. Include finish to coordinate with finishes shown on Plumbing Fixture Schedule. Coordinate fittings with other components and connectors.
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Automatic Flow Restrictors: ASSE 1028.
 3. Brass and Copper, Supplies and Tubular Brass: ASME A112.18.1M.
 4. Fixed Flow Restrictors: ASSE 1034.
 5. Manual-Operation Flushometers: ASSE 1037.

2.07 MISCELLANEOUS COMPONENT STANDARDS

- A. Comply with applicable standards below and other requirements specified for components for plumbing fixtures, equipment, and appliances.
1. Disposers: ASSE 1008 and UL 430.
 2. Floor Drains: ASME A112.21.1M.
 3. Hose-Coupling Threads: ASME B1.20.7.
 4. Pipe Threads: ASME B1.20.1.
 5. Plastic Shower Receptors: ANSI Z124.2 and ANSI Z124.2a.
 6. Plastic Toilet Seats: ANSI Z124.5.
 7. Supply and Drain Insulation Kits: CABO A117.1.
 8. Supports: ASME A112.6.1M.

2.08 FITTINGS

- A. Fittings for Plumbing Fixtures: Provide all required supplies, supply stops, supply risers, traps, and other fittings.
- B. Fittings for Equipment Specified in Other Sections: Fittings include the following:
1. Supply Inlets: Brass pipe or copper tube, size required for final connection.
 2. Supply Stops: Chrome-plated brass, angle or straight; compression, loose-key type; same size as supply inlet and with outlet matching supply riser.
 3. Supply Risers: 3/8-inch NPS (DN10) rigid brass tube with 1/4-inch NPS (DN8) offset, knob-end tailpiece. Use chrome-plated tube for exposed applications.
 4. Traps: Tubular brass with 0.045-inch wall thickness, slip-joint inlet, cleanout, wall flange, escutcheons, and size to match equipment. Use chrome-plated tube for exposed applications.

5. Continuous Waste: Tubular brass, 0.045-inch wall thickness, with slip-joint inlet, and size to match equipment.
6. Indirect Waste: Tubular brass, 0.045-inch wall thickness, and size to match equipment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for potable, hot- and cold-water supply piping systems; soil, waste, and vent piping systems; and supports. Verify that locations and sizes of piping and locations and types of supports match those indicated, before installing and connecting fixtures. Use manufacturer's roughing-in data when roughing-in data are not indicated.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Include supports for plumbing fixtures according to the following:
 1. Carriers: For wall-hanging water closets and fixtures supported from wall construction.
 2. Chair Carriers: For wall-hanging urinals, lavatories, sinks, drinking fountains, and electric water coolers.
 3. Heavy-Duty Chair Carriers: For accessible urinals, lavatories, and other fixtures where indicated.
 4. Reinforcement: For floor-mounted lavatories and sinks that require securing to wall and recessed, box-mounted, electric water coolers.
 5. Fabricate reinforcement from 2-by-4-inch or 2-by-6-inch fire-retardant-treated-wood blocking between studs or 1/4-by-6-inch steel plates attached to studs, in wall construction, to secure fixtures to wall. Include length that will extend beyond ends of fixture mounting bracket and attach to at least 2 studs.
- B. Include fitting insulation kits for accessible fixtures according to the following:
 1. Lavatories: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
 2. Sinks: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
 3. Fixtures with Offset Drain: Cover hot- and cold-water supplies, offset drain, trap, and waste to wall.
 4. Other Fixtures: Cover exposed fittings below fixture.

3.03 PLUMBING FIXTURE INSTALLATION

- A. Assemble plumbing fixtures and trim, fittings, faucets, and other components according to manufacturers' written instructions.
- B. Install fixtures level and plumb according to manufacturers' written instructions, roughing-in drawings, and referenced standards.
- C. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.
- D. Install floor-mounted, back-outlet water closets with fittings and gasket seals.

- E. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gage.
- F. Install shower arm elbow fitting secure to backing to prevent movement.
- G. Install toilet seats on water closets.
- H. Install wall-hanging, back-outlet urinals with gasket seals.
- I. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for handicapped people to reach.
- J. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- K. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.
- L. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.
- M. Fasten recessed, wall-mounted fittings to reinforcement built into walls.
- N. Fasten wall-mounted fittings to reinforcement built into walls.
- O. Fasten counter-mounting plumbing fixtures to casework.
- P. Secure supplies to supports or substrate within pipe space behind fixture.
- Q. Set shower receptors and mop basins in leveling bed of cement grout.
- R. Install individual stop valve in each water supply to fixture. Use gate or globe valve where specific stop valve is not specified.
 - 1. Exception: Omit stop valves on supplies to emergency equipment, except when permitted by authorities having jurisdiction. When permitted, install valve chained and locked in OPEN position.
- S. Install water-supply stop valves in accessible locations.
- T. Install faucet, laminar-flow fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.
- U. Install supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- V. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.
- W. Install shower, flow-control fittings with specified maximum flow rates in shower arms.
- X. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes, except where otherwise indicated.
- Y. Install disposers in sink outlets. Install switch where indicated, or in wall adjacent to sink if location is not indicated.
- Z. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.

- AA. Seal joints between fixtures and walls, floors, and counters using sanitary-type, 1-part, mildew-resistant, silicone sealant according to sealing requirements specified in Section 07 92 00 (07920) - "Joint Sealants." Match sealant color to fixture color.

3.04 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other Division 22 Sections.
- B. Supply and Waste Connections to Plumbing Fixtures: Refer to plumbing fixture schedules within Contract Drawings for fitting sizes and connection requirements for each plumbing fixture.
- C. Supply and Waste Connections to Equipment Specified in Other Sections: Connect equipment with supply inlets, supply stops, supply risers, and traps specified in this Section. Use fitting sizes required to match connected equipment. Connect fittings to plumbing piping.
- D. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- E. Arrange for electric-power connections to fixtures and devices that require power. Electric power is specified in Division 16 Sections.

3.05 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized and demonstrate proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.06 ADJUSTING AND CLEANING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers, hot-water dispensers, and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at drinking fountains, electric water coolers, faucets, shower valves, and flushometer valves having controls, to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Include the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.

3.07 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities, except when approved in writing by Owner.

END OF SECTION

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. HVAC Pipe and Pipe Fittings
2. Joining Materials
3. HVAC Sleeves
4. HVAC Sleeve Seals
5. HVAC Specialties
6. HVAC Piping System Installation
7. HVAC Equipment Installation
8. Concrete Bases.
9. Erection of Metal Supports
10. Cutting and Patching

B. Related Sections:

1. Section 01 31 00 - Project Management and Coordination
2. Section 01 73 29 - Cutting and Patching
3. Section 01 78 43 - Spare Parts and Materials
4. Section 01 79 00 - Training
5. Section 01 78 23 - Operating and Maintenance Data
6. Section 03 30 00 - Cast-in-Place Concrete
7. Section 06 10 01 - Rough Carpentry
8. Section 07 62 00 - Sheet Metal Flashing and Trim
9. Section 07 84 00 - Firestopping
10. Section 08 31 00 - Access Doors
11. Section 09 90 00 - Painting
12. Section 23 05 53 – Identification for HVAC Piping and Equipment: Labeling and identifying HVAC systems and equipment.
13. Section 31 20 00 – Earth Moving

1.02 REFERENCES

A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"
2. B32 "Standard Specification for Solder Metal"
3. C1107 "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)"

B. American Welding Society (AWS) Publications:

1. BRH "Brazing Handbook"
2. A5.8 "Specification for Filler Metals For Brazing And Braze Welding"
3. D1.1 "Structural Welding Code - Steel"
4. D10.12 "Guide for Welding Mild Steel Pipe"

C. Copper Development Association (CDA) Publications:

1. "Copper Tube Handbook"

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 2. CPVC: Chlorinated polyvinyl chloride plastic.
 3. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 1. Product Data: For dielectric fittings, flexible connectors, plumbing sleeve seals, and identification materials and devices.
 2. Coordination Drawings: Detail major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 - a. Planned piping layout, including valve and specialty locations and valve-stem movement.
 - b. Clearances for installing and maintaining insulation.
 - c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - d. Equipment and accessory service connections and support details.

- e. Exterior wall and foundation penetrations.
- f. Fire-rated wall and floor penetrations.
- g. Sizes and location of required concrete pads and bases.
- h. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
- i. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.05 QUALITY ASSURANCE

- A. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting plumbing and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases.
 - 1. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design requirements. See drawings for equipment schedules and requirements.

1.06 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 prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 SEQUENCING AND SCHEDULING

- A. Coordinate HVAC equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of HVAC systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Section 08 31 00 - "Access Doors and Panels."
- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.08 Posted Operating Instructions

- A. Provide and post operating instructions for all HVAC systems.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:

1. HVAC Sleeve Seals:
 - a. Metraflex Inc.
 - b. PSI-Thunderline/Link-Seal

2.02 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B32.

1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.
3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.
4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.
5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.

- B. Brazing Filler Metals: AWS A5.8.

1. BCuP Series: Copper-phosphorus alloys.
2. BAg1: Silver alloy.
3. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.03 HVAC SLEEVES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
2. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.
3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.

2.04 HVAC SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.05 HVAC SPECIALTIES

A. Grout:

1. Non-shrink, Nonmetallic Grout: ASTM C1107, Grade B.
 - a. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
 - b. Design Mix: 5000-psig, 28-day compressive strength.
 - c. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 HVAC PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install HVAC piping as described below, unless piping Sections specifies otherwise. Individual Division 23 Piping Sections specifies unique piping installation requirements.
- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings as required by Division 01 Sections and as outlined in Part 1 of this section.
- C. Install components with pressure rating equal to or greater than system operating pressure.
- D. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- E. Install piping free of sags and bends.
- F. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- G. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- H. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- I. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping rings where required.
 2. Build sleeves into walls and slabs as work progresses.
 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 4. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant.
- J. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.

3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stopping materials. Refer to Section 07 84 00 - "Firestopping" for materials.
- L. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- M. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to CDA's "Copper Tube Handbook."
 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

3.02 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights is not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Owner's Representative.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install mechanical 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.
- E. Clearance from Electrical Equipment: Piping and ductwork are prohibited in electric rooms and closets, elevator machine rooms and installation over transformers, switchboards and motor control centers.

3.03 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."
- C. Prime and paint all metal supports per Section 09 90 00 requirements similar to "Pipes and Mechanical Equipment".

3.04 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.
- C. Refer to Division 01 Sections for additional requirements.

3.05 GROUTING

- A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Basic Motor Requirements
2. Polyphase Motors
3. Single Phase Motors

B. Related Sections:

1. Division 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.02 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE) Publications:

1. 112 "Standard Test Procedure for Polyphase Induction Motors and Generators"

B. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. MG 1 "Motors and Generators"

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.

1.04 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Listing and Labeling: Provide motors specified in this Section that are listed and labeled.

1. Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.

PART 2 PRODUCTS

2.01 BASIC MOTOR REQUIREMENTS

- A. Basic requirements apply to mechanical equipment motors, unless otherwise indicated.
- B. Motors 1/2 HP and Larger: Polyphase.
- C. Motors Smaller than 1/2 HP: Single phase.
- D. Frequency Rating: 60 Hz.
- E. Voltage Rating: Determined by voltage of circuit to which motor is connected.
- F. Service Factor: According to NEMA MG 1, general purpose continuous duty, design type "B."

- G. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- H. Enclosure: Open drip-proof, unless otherwise indicated.
- I. Efficiency: Motors shall have a higher efficiency rating than industry standard average motor as delineated in IEEE Standard 112, Test Method 13.

2.02 POLYPHASE MOTORS

- A. Description: NEMA MG 1, medium induction motor.
 - 1. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated.
 - 2. Energy-Efficient Design: Where indicated.
 - 3. Stator: Copper windings, unless otherwise indicated. Multi-speed motors have separate winding for each speed.
 - 4. Rotor: Squirrel cage, unless otherwise indicated.
 - 5. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
 - 6. Temperature Rise: Match insulation rating, unless otherwise indicated.
 - 7. Insulation: Class F, unless otherwise indicated.
- B. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for indicated controller, with required motor leads brought to motor terminal box to suit control method.
- C. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Critical vibration frequencies are not within operating range of controller output.
 - 2. Temperature Rise: Match rating for Class B insulation.
 - 3. Insulation: Class H
 - 4. Thermal Protection: Where indicated, conform to NEMA MG 1 requirements for thermally protected motors.
- D. Source Quality Control: Perform the following routine tests according to NEMA MG 1:
 - 1. Measurement of winding resistance.
 - 2. No-load readings of current and speed at rated voltage and frequency.
 - 3. Locked rotor current at rated frequency.
 - 4. High-potential test.
 - 5. Alignment

2.03 SINGLE-PHASE MOTORS

- A. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.
 - 1. Permanent-split capacitor.

2. Split-phase start, capacitor run.
 3. Capacitor start, capacitor run.
- B. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 hp.
- C. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.
- D. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, pre-lubricated sleeve bearings for other single-phase motors.

PART 3 EXECUTION

3.01 ADJUSTING

- A. Use adjustable motor mounting bases for belt-driven motors.
- B. Align pulleys and install belts.
- C. Tension according to manufacturer's written instructions.

END OF SECTION

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Hangers And Supports For HVAC System Piping And Equipment.

B. Related Sections:

1. Section 05 50 00 - Metal Fabrications
2. Section 09 90 00 - Painting
3. Section 23 05 48– Vibration and Seismic Control for HVAC Piping and Equipment

1.02 REFERENCES

A. The American Society of Mechanical Engineers (ASME) Publications:

1. B31.9 "Building Services Piping"

B. American Welding Society (AWS) Publications:

1. D1.1 "Structural Welding Code - Steel"

C. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. A36 "Standard Specification for Carbon Structural Steel"
2. A780 "Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings"
3. C552 "Standard Specification for Cellular Glass Thermal Insulation"
4. C1107 "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)"

D. Metal Framing Manufacturers Association (MFMA)

E. Manufacturers Standardization Society of the Valve and Fittings Industry. (MSS) Publications:

1. SP-6 "Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings"
2. SP-58 "Pipe Hangers and Supports - Materials, Design, and Manufacture"
3. SP-69 "ANSI/MSS Edition Pipe Hangers and Supports - Selection and Application"
4. SP-89 "Pipe Hangers and Supports -Fabrication and Installation Practices"

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports.

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data:

- a. For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

1.05 QUALITY ASSURANCE

- A. Engineering Responsibility: Where required by the local authority having jurisdiction design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and seismic restraint by a qualified professional engineer.
 1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 1. Pipe Hangers, Supports, and Components:
 - a. Cooper B-Line, Inc.
 - b. Grinnell Mechanical Products,
 - c. National Pipe Hanger Corporation
 2. Channel Support Systems:
 - a. Cooper B-Line, Inc.
 - b. Grinnell Mechanical Products
 - c. National Pipe Hanger Corporation
 3. Thermal-Hanger Shield Inserts:
 - a. Carpenter & Patterson, Inc.
 - b. Erico (Michigan Hanger)
 - c. PHS Industries, Inc.
 4. Powder-Actuated and Mechanical Anchor Fastener Systems:
 - a. Gunnebo Fastening Corp.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head

2.02 HANGERS AND SUPPORTS

- A. Pipe Hangers, Supports, and Components:
 1. MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
 - a. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
 - b. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

- B. Channel Support Systems:
 - 1. MFMA-2, Factory-fabricated components for field assembly.
 - 2. Coatings: Manufacturer's standard finish.
 - 3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts:
 - 1. 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
 - 2. Material for Cold Piping: ASTM C552, Type I cellular glass.
 - 3. Material for Hot Piping: ASTM C552, Type I cellular glass.
 - 4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 - 5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
 - 6. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.03 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Structural Steel: ASTM A36, steel plates, shapes, and bars, black and galvanized.
- D. Grout: ASTM C1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

- A. General:
 - 1. Specific hanger requirements are specified in Sections specifying equipment and systems.
 - 2. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- B. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification 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. 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.

3. 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.
 4. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 6. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 7. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 8. 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.
- C. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500).
- D. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
- E. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 3. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 4. C-Clamps (MSS Type 23): For structural shapes.
 5. 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.
- F. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification 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 by manufacturer to prevent crushing insulation.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 - 1. Field assemble and install according to manufacturer's written instructions.
- C. Install building attachments to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.
- D. Install powder-actuated drive-pin fasteners 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.
- E. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- J. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9.
 - 2. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN8 to DN90): 12 inches long and 0.048 inch thick.
 - b. NPS 4 (DN100): 12 inches long and 0.06 inch thick.
 - 5. Insert Material: Length at least as long as protective shield.

3.03 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Prime and Paint Equipment Supports as specified in Section 09 90 00 "Painting".

3.04 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments to level equipment and to achieve indicated slope of pipe.

3.06 PAINTING

- A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09 90 00 "Painting".
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Vibration Isolators.
2. Vibration Isolation Bases.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete
2. Section 04 20 00 - Unit Masonry
3. Section 05 12 00 - Structural Steel
4. Section 06 10 01 - Rough Carpentry
5. Section 09 90 00 - Painting
6. Section 23 05 00– Common Work Results for HVAC
7. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: for pipe hanger restraints.
8. Section 23 31 13 - Metal Ducts: for flexible duct connectors.

1.02 REFERENCES

A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. A36 “Standard Specification for Carbon Structural Steel”

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data: Indicate types, styles, materials, and finishes for each type of isolator specified. Include load deflection curves.
2. Shop Drawings: Show designs and calculations, certified by a professional engineer, as required by the local authority, for the following:
 - a. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, and selection of seismic restraints.
 - b. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to the structure and to the supported equipment. Include auxiliary motor slides and rails, and base weights.
 - c. Seismic Restraint Details: Detail fabrication and attachment of restraints and snubbers.

1.04 COORDINATION

- A. Coordinate layout and installation of vibration isolation and seismic-restraint devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

- B. Coordinate size and location of concrete housekeeping and vibration isolation bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03 Sections.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Sections.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Cooper B-Line Systems, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.

2.02 VIBRATION ISOLATORS

- A. Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.
 - 1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
 - 2. Load Range: From 10 to 50 psig and a deflection not less than 0.08 inch per 1 inch of thickness. Do not exceed a loading of 50 psig.
- B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.
- C. Spring Isolators: Freestanding, laterally stable, open-spring-type isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 3. Lateral Stiffness: More than 1.2 times the rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 5. Baseplates: Factory drilled for bolting to structure and bonded to a 1/4-inch- thick, rubber isolator pad attached to the baseplate underside. Size baseplates to limit floor loading to 100 psig.
 - 6. Top Plates: Provide threaded studs for fastening and leveling equipment.
 - 7. Finishes: Manufacturer's standard corrosive-resistant finish.
- D. Restrained Spring Isolators: Vertically restrained, freestanding, laterally stable, steel open-spring-type isolators.
 - 1. Housing: Welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Factory-drilled baseplate for bolting to structure and bonded to a 1/4-inch thick, rubber isolator pad attached to the baseplate underside. Provide adjustable equipment mounting and leveling bolt.

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 0.8 times the rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.
- E. Rubber Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to formed-steel housings with threaded connections for hanger rods. Color-code to indicate capacity range.
- F. Spring Hangers: Combination spring and elastomeric hanger with coil spring and elastomeric insert in compression.
1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

2.03 VIBRATION ISOLATION BASES

- A. Fabricated Steel Bases: Structural-steel bases and rails designed and fabricated by the isolation equipment manufacturer. Include equipment static loadings, power transmission, component misalignment, and cantilever loadings.
1. Fabricate bases to shapes required, with welded structural-steel shapes, plates, and bars conforming to ASTM A36. Include support brackets to anchor base to isolation units. Include prelocated equipment anchor bolts and auxiliary motor slide bases or rails.
 2. Design and fabricate bases to result in the lowest possible mounting height with not less than 1-inch clearance above the floor.
 3. Weld steel angles on frame for outrigger isolation mountings, and provide for anchor bolts and equipment support.
 4. Factory Finish: Manufacturer's standard corrosive-resistant finish.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install and anchor vibration-, sound-, and seismic-control products according to manufacturer's written instructions and authorities having jurisdiction.
- B. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.
- C. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required by authorities having jurisdiction.

- D. Install pipe connectors at connections for equipment supported on vibration isolators.

3.02 ADJUSTING AND CLEANING

- A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operations.
- B. Adjust thrust restraints for a maximum of 1/4 inch of movement at start and stop

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Identifying Devices and Labels
- B. Related Sections:
 - 1. Section 23 05 00– Common Work Results for HVAC

1.02 REFERENCES

- A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
 - 1. C1036 “Standard Specification for Flat Glass”
- B. The American Society of Mechanical Engineers (ASME) Publications:
 - 1. A13.1 “Scheme for the Identification of Piping Systems”

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 - 1. Product Data: For identification materials and devices.
 - 2. Samples: Of color, lettering style, and graphic representation required for each identification material and device.

1.04 QUALITY ASSURANCE

- A. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

1.05 SEQUENCING AND SCHEDULING

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 GENERAL

- A. General: Products specified are for applications referenced in other Division 23 Sections. If more than single type is specified for listed applications, selection is Installer's option.
- B. Pipes Including Insulation: Full-band pipe markers, extending 360 degrees around pipe at each location.

2.02 IDENTIFYING DEVICES AND LABELS

- A. Lettering: Manufacturer's standard preprinted captions as selected by Owner's Representative.
- B. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 - 1. Arrows: Either integrally with piping system service lettering, to accommodate both directions, or as separate unit, on each pipe marker to indicate direction of flow.

- C. Plastic Duct Markers: Manufacturer's standard laminated plastic, in the following color codes:
 - 1. Green: Cold-air supply.
 - 2. Yellow: Hot-air supply.
 - 3. Blue: Exhaust, outside, return, and mixed air.
 - 4. Terminology: Include direction of airflow; duct service such as supply, return, and exhaust; duct origin, duct destination, and design flow.
- D. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 3 mils thick.
 - 1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
 - 2. Color: Comply with ASME A13.1, unless otherwise indicated.
- E. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch thick, polished brass.
 - 2. Size: 1-1/2-inches diameter, unless otherwise indicated.
- F. Valve Tag Fasteners: Brass, wire-link chain and S-hooks.
- G. Access Panel Markers: 1/16-inch thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve. Provide 1/8-inch center hole for attachment.
- H. Valve Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include screws.
 - 1. Frame: Extruded aluminum.
 - 2. Glazing: ASTM C1036, Type I, Class 1, Glazing quality B, 2.5-mm, single-thickness glass.
- I. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.
 - 1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

PART 3 EXECUTION

3.01 LABELING AND IDENTIFYING PIPING SYSTEMS

- A. Install pipe markers on each system as indicated below. Include arrows showing normal direction of flow.
 - 1. Condensate.
- B. Marker Type: Plastic markers, with application systems. Install on pipe insulation segment where required for hot, noninsulated pipes.
- C. Fasten markers on pipes and insulated pipes by one of following methods:
 - 1. Snap-on application of pretensioned, semirigid plastic pipe marker.

- D. Locate pipe markers where piping is exposed in machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations according to the following:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 - 3. Near penetrations through walls, floors, ceilings, or nonaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.02 LABELING AND IDENTIFYING DUCT SYSTEMS.

- A. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows showing service and direction of flow.
 - 1. Location: Locate signs near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.03 ADJUSTING AND CLEANING

- A. Relocate HVAC identification materials and devices that have become visually blocked by work of this or other Divisions.
- B. Clean faces of identification devices and glass frames of valve charts

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Balancing airflow within distribution systems, including sub-mains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC and plumbing equipment.
4. Setting quantitative performance of HVAC and plumbing equipment.
5. Verifying that automatic control devices are functioning properly.
6. Reporting results of the activities and procedures specified in this Section.
7. Adjustment of recirculating domestic hot water return system.
8. Verify performance of package terminal air conditioning units.

B. Related Sections:

1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.02 REFERENCES

- A. Associated Air Balance Council (AABC): "National Standards for Testing, Adjusting and Balancing"
- B. Air Movement & Control Association International, Inc. (AMCA): 201, "Fans and Systems"
- C. National Environmental Balancing Bureau (NEBB): "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems"
- D. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): "HVAC Systems--Duct Design"

1.03 DEFINITIONS

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

- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- C. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents Review Report as specified in Part 3 of this Section.
- D. Submittals Examination Report: Prior to the start of duct or piping fabrication, submit 2 copies of the Submitted Examination Report as specified in Part 3 of this Section.
- E. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

1.05 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.
- B. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- C. Testing, Adjusting, and Balancing Reports: Use testing, adjusting, and balancing standard forms from AABC's "National Standards for Testing, Adjusting and Balancing" or NEBB's "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems".

- D. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.
- E. Testing, Adjusting, and Balancing Conference: Meet with the Owner's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location. As a minimum include the following agenda items:
 - 1. Submittal distribution requirements.
 - 2. Contract Documents examination report.
 - 3. Testing, adjusting, and balancing plan.
 - 4. Work schedule and Project site access requirements.
 - 5. Coordination and cooperation of trades and subcontractors.

1.06 COORDINATION

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

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine Contract Documents to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment and submit "Contract Documents Examination Report".
 - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 - 3. Examine Engineer's design data, including HVAC and Plumbing system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC and Plumbing systems and equipment controls.
- B. Examine approved submittal data of HVAC and Plumbing systems and equipment including sheet metal duct fabrication and plumbing piping shop drawings to ensure that the distribution system is reasonably complete and sufficiently designed to accurately balance the complete building. Submit "Submitting Examination Report".

1. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 07 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 05 and 06. Compare this data with the design data and installed conditions.
- C. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
 1. Examine HVAC and Plumbing systems and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 2. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
 3. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
 4. Examine terminal units to verify that they are accessible and their controls are connected and functioning.
 5. Examine plenum ceilings, utilized for return air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
 6. Examine equipment for installation and for properly operating safety interlocks and controls.
 7. Examine automatic temperature system components to verify the following:
 - a. Dampers, and other controlled devices operate by the intended controller.
 - b. Dampers are in the position indicated by the controller.
 - c. Integrity dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in variable-air-volume terminals.
 - d. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - e. Sensors are located to sense only the intended conditions.
 - f. Sequence of operation for control modes is according to the Contract Documents.
 - g. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - h. Interlocked systems are operating.
- D. Examine project record documents described in Section 01 78 39 - "Project Record Documents".
- E. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.02 PREPARATION

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are properly located, sized, and securely closed.
 - 4. Verify that smoke and fire dampers are open.
 - 5. Access to balancing devices is provided.
 - 6. Windows and doors can be closed so design conditions for system operations can be met.

3.03 GENERAL TESTING AND BALANCING PROCEDURES

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

3.04 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic single line diagrams of systems' "as-built" duct layouts and domestic hot water distribution.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.

3.05 AIR SYSTEMS' BALANCING PROCEDURES

- A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems.
- B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each air-handling unit component.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 5. Adjust fan speed higher or lower than design with the approval of the Owner's Representative. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
- C. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to design airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in sub-mains and branch ducts is unavailable for Pilot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust sub-mains and branch ducts to design airflows within specified tolerances.
- D. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.

- E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
 - 1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 MOTORS

- A. Motors: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor RPM.
 - 4. Efficiency rating if high-efficiency motor.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.

3.07 CONDENSING UNITS

- A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.08 HEAT-TRANSFER COILS

- A. Electric-Heating Coils: Measure the following data for each coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperatures at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kW at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.

3.09 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor and outdoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

3.10 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.

- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Confirm interaction of electrically operated switch transducers.
- G. Confirm interaction of interlock and lockout systems.
- H. Verify main control supply-air pressure and observe compressor and dryer operations.
- I. Record voltages of power supply and controller output. Determine if the system operates on a grounded or non-grounded power supply.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.11 TOLERANCES

- A. Set HVAC system airflow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.
- B. Set plumbing system water flow rates within the following tolerances:
 - 1. Domestic Hot Water Recirculation Flow Rate: 0 to minus 10 percent.

3.12 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of testing, adjusting, and balancing Agent.
 - 3. Project name.
 - 4. Project location.
 - 5. Owner's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.

8. Report date.
9. Signature of testing, adjusting, and balancing Agent who certifies the report.
10. Summary of contents, including the following:
 - a. Design versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.
14. Test conditions for fans and pump performance forms, including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air distribution systems and domestic hot water distribution systems. Present with single-line diagrams and include the following:
 1. Quantities of outside, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Location of manual volume control dampers.
 4. Water flow meter.
 5. Balancing valve sizes/locations.
- F. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 1. Fan Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches and bore.
 - h. Sheave dimensions, center-to-center and amount of adjustments in inches.
 2. Motor Data: Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.

- d. Full-load amperage and service factor.
 - e. Sheave make, size in inches and bore.
 - f. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
 - g. Number of belts, make, and size.
 - 3. Test Data: Include design and actual values for the following:
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
 - G. Gas-Fired Heat Apparatus Test Reports; i.e., unit heaters, duct furnaces, domestic water heaters.
 - H. Electric Coil Test Reports; i.e., electric baseboards, electric unit heaters, electric cabinet heaters.
 - I. Duct Traverse Reports.
 - J. Air Terminal Device Reports; i.e., diffusers/registers/grilles.
 - K. Pool Dehumidification Test Reports.
 - L. Package Terminal Air Conditioning Test Reports; including equipment leveling to ensure condensate is pitched to building exterior.
 - M. Plumbing Pump Test Reports including recirculating hot water and sump pumps.
 - N. Instrument Calibration Reports.
- 3.13 ADDITIONAL TESTS
- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
 - B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 00 - HVAC INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Insulation Materials
2. Jackets
3. Accessories and Attachments
4. Vapor Retarders

B. Related Sections:

1. Section 07 84 00 - Firestopping: Firestopping materials and requirements for penetrations through fire and smoke barriers.
2. Section 22 07 00 - Plumbing Insulation
3. Section 23 31 13 - Metal Ducts: For duct liner.

1.02 REFERENCES

A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. A666 "Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar"
2. C533 "Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation"
3. C534 "Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form"
4. C612 "Standard Specification for Mineral Fiber Block and Board Thermal Insulation"
5. C921 "Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation"
6. C1126 "Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation"
7. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"

B. Military Specifications:

1. MIL-C-20079H "Cloth, Glass; Tape, Textile Glass and Thread, Glass and Wire-Reinforced Glass"

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data:

- a. Identify thermal conductivity, thickness, and jackets (both factory and field applied) for each type of product indicated.

2. Shop Drawings:

- a. Submit manufacturer's data for each type of insulation used.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or similar industry recognized craft training program.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.06 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.

1.07 SCHEDULING

- A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Mineral-Fiber Insulation:
 - a. CertainTeed Corp.
 - b. Knauf Insulation.
 - c. Owens-Corning Fiberglas Corp.
 - 2. Mineral-Fiber Blanket Thermal Insulation:
 - a. CertainTeed Corp.
 - b. Knauf Insulation.
 - c. Owens-Corning Fiberglas Corp.
 - 3. Closed-Cell Phenolic-Foam Insulation:
 - a. "Kooltherm Pipe Insulation"; Kingspan Insulation Ltd.
 - 4. Flexible Elastomeric Thermal Insulation:
 - a. Armstrong World Industries
 - b. Rubatex International LLC

2.02 INSULATION MATERIALS

- A. Mineral-Fiber Board Thermal Insulation:

1. Glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IB, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
 - B. Mineral-Fiber Blanket Thermal Insulation:
 1. Glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
 - C. Closed-Cell Phenolic-Foam Insulation:
 1. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126, Type II, Grade 1.
 - D. Flexible Elastomeric Thermal Insulation:
 1. Closed-cell, sponge or expanded-rubber materials.
 2. Comply with ASTM C534, Type I for tubular materials and Type II for sheet materials
 - a. Adhesive: As recommended by insulation manufacturer.
 - b. Ultraviolet Protective Coating: As recommended by insulation manufacturer.
- 2.03 FIELD-APPLIED JACKETS
- A. General: ASTM C921, Type 1, unless otherwise indicated.
 - B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- 2.04 ACCESSORIES AND ATTACHMENTS
- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd.
 1. Tape Width: 4 inches.
 - B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
 1. Stainless Steel: ASTM A666, Type 304; 0.020 inch thick.
 2. Galvanized Steel: 0.005 inch thick.
 3. Aluminum: 0.007 inch thick.
 4. Brass: 0.010 inch thick.
 5. Nickel-Copper Alloy: 0.005 inch thick.
 - C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
 - D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.
 - E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100.
- F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.05 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- F. Keep insulation materials dry during application and finishing.
- G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- H. Apply insulation with the least number of joints practical.
- I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
- K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- L. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.
1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
 2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 3. Seal insulation to roof flashing with vapor-retarder mastic.
- P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- Q. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- R. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.04 MINERAL-FIBER INSULATION APPLICATION

- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.

- c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
- d. Do not overcompress insulation during installation.
- 4. Impale insulation over anchors and attach speed washers.
- 5. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- 6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
- 7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
- 8. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 9. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
- 10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.05 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

A. Apply insulation as follows:

- 1. Secure each layer of insulation to duct with stainless-steel bands at 12-inch intervals and tighten without deforming the insulation materials.
- 2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless-steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
- 3. On exposed applications, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

3.06 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

- 1. Follow manufacturer's written instructions for applying insulation.
- 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

- 1. Apply pipe insulation to outer diameter of pipe flange.
- 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- C. Apply insulation to fittings and elbows as follows:
 1. Apply mitered sections of pipe insulation.
 2. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Apply insulation to valves and specialties as follows:
 1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
 2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
 3. Apply insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.07 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
 1. Apply 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 jacket manufacturer's recommended adhesive.
 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.08 DUCT SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.
- C. Insulate the following plenums and duct systems:
 1. Indoor concealed supply-, return-, and outside-air ductwork.
 2. Outdoor exposed supply ductwork.
- D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 1. Indoor exposed metal ducts, unless noted otherwise.
 2. Metal ducts with duct liner, unless noted otherwise.
 3. Factory-insulated flexible ducts.

4. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections, unless noted otherwise.
5. Flexible connectors.
6. Vibration-control devices.
7. Testing agency labels and stamps.
8. Nameplates and data plates.
9. Access panels and doors in air-distribution systems.

END OF SECTION

SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Control Panels
2. Thermostats
3. Carbon Dioxide Sensors
4. Actuators
5. Dampers
6. Wiring

B. Related Sections:

1. Section 23 09 93 - Sequence of Operations for HVAC Controls
2. Section 23 74 33 – Dedicated Outdoor Air Units
3. Section 23 81 13.13 – Packaged Terminal Air Conditioning Units
4. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables

1.02 REFERENCES

A. Air Movement & Control Association International, Inc. (AMCA) Publications:

1. 500D "Laboratory Methods of Testing Dampers for Rating"

B. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. DC 3 "Residential Controls—Electrical Wall-Mounted Room Thermostats"

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"
2. 90A "Standard for the Installation of Air Conditioning and Ventilating Systems"

D. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

E. Underwriter's Laboratories, Inc. (UL) Standards:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors"
2. 486B "Standard for Wire Connectors for Use With Aluminum Conductors"

1.03 SYSTEM DESCRIPTION

- A. Electric/Digital Electronic system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product Data:

- a. Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - b. Each control device labeled with setting or adjustable range of control.
2. Shop Drawings: For each system to be controlled, prepare a drawing which includes a system flow diagram, control diagram, sequence of operation and schedule of components. Control diagrams shall be complete with end-to-end connections of wiring from component terminal.
3. Operation and Maintenance Data: Submit information for all products in accordance with the requirements of Specification " 01 78 23- "Operating and Maintenance Data".

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- E. The provision of 120 and 208 line voltage and 24 volt low voltage wiring, conduit, installed in accordance with National Fire Protection Association (NFPA) 70, "National Electric Code" and Division 26 of these specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.07 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

1.08 TRAINING

- A. Submit in accordance with the requirements of specification Section 01 79 00 (01820).

PART 2 PRODUCTS

2.01 CONTROL PANELS

1. Approved Manufacturers:
 - a. Siemens USA
 - b. Invensys Controls (formally Siebe Environmental Controls)
 - c. Honeywell Inc., Automation and Control Solutions
 - d. Automated Logic Controls, a Unit of United Technologies Corp. (770-429-3000)

- B. Local Control Panels: Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
 - 1. Fabricate panels of 0.06-inch thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
 - 2. Panel-Mounted Equipment: Mounted transformers, relays, and automatic switches; except safety devices. Mount devices with adjustments accessible through front of panel.
 - 3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.

2.02 THERMOSTATS

- A. Manufacturers:
 - 1. Avendra, LLC Preferred Manufacturers:
 - a. PSG Controls, Inc.
 - 1) "HotelStat Model 5-10505" (Heat Pump with backup Electric Heat)
 - b. Carrier Corp.; Carrier Air Conditioning Division, United Technologies Corporation
 - 1) "Debonair Model 33CSSN2-MH"
 - c. Trane, an Ingersoll Rand Brand
 - 1) "Zone Controller (Thermostat)"
- B. Combination Thermostat and Fan Switches: Line-voltage or low voltage thermostat with two-, three-, or four-position, push-button or lever-operated fan switch.
 - 1. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF," "FAN HIGH-MED-LOW-OFF." Provide unit for mounting on two-gang switch box.
- C. Electric solid-state, microcomputer-based room thermostat with remote sensor. (Where indicated on drawings.)
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from set point.
 - 3. Set up for four separate temperatures per day.
 - 4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
 - 5. Short-cycle protection.
 - 6. Programming based on every day of week.
 - 7. Selection features include deg F display, 12- or 24-hour clock, keyboard disable, remote sensor, fan on-auto.
 - 8. Battery replacement without program loss.
 - 9. Thermostat backlit display features include the following:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.

- d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indications include "heating," "off," "fan auto," and "fan on."
- D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.
- E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
 - 1. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break ungrounded conductors.
 - 2. Dead Band: Maximum 2 deg F.
- F. Room Thermostat Cover Construction: Manufacturer's standard locking covers.
- G. Room thermostat accessories include the following:
 - 1. Insulating Bases: For thermostats located on exterior walls.
 - 2. Thermostat Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
 - 3. Adjusting Key: As required for calibration and cover screws.
 - 4. Aspirating Boxes: For flush-mounted aspirating thermostats.
 - 5. Set-Point Adjustment: 1/2-inch-diameter, adjustment knob.

2.03 SENSORS

- A. Carbon-Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C), calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted between three (3) and six (6) feet above the finish floor.
- B. Fan Current Transducer on DOAS units: calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output.

2.04 ACTUATORS

- A. Electric Motors: Spring-return type operators, sized to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - 1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - 2. Temperature Rating: Minus 22 to plus 122 deg F.
 - 3. Damper Operator Mounting: Mount damper operators where accessible for maintenance.
 - a. If located outside the duct or casing, mount operators on a 14 gauge reinforced support plate arranged to allow insulation between the support plate and the face of the duct or casing.
 - b. Brace damper operators rigid to show no deflection or movement over the full range of the damper stroke.

2.05 DAMPERS

- A. Dampers: Factory fabricated AMCA-rated opposed blade design of extruded aluminum, galvanized steel, with metallic antifriction nonferrous bearings.
1. Blades shall be secured to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 3. Pressure Rating: Rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4 inches wg when damper is being held by torque of 50 in. x lbf when tested according to AMCA 500D.
 4. Shafts and Bearings: Provide cadmium plated steel shafts in permanently lubricated bronze sleeve bearings or permanently lubricated ball bearings.
 5. Blade: Reinforced or ribbed blades shall not exceed 8 inches in width nor 48 inches in length.
 - a. Blades shall be constructed of 16 gage (minimum) galvanized steel or extruded aluminum.
 - b. Flat or un-reinforced blades will not be acceptable.
 - c. Damper sections exceeding 4 feet in width or 4 feet height shall be constructed with multiple frames and linkages.
 6. Frames: Construct frames of factory welded 13 gage (minimum) galvanized steel hot dipped after construction or bolted extruded aluminum frames.
 - a. Dampers larger than 8 square feet in area shall have corner bracing gussets at each corner welded to the damper frame.
 7. Linkages: Provide linkages to uniformly transmit damper operating forces to each damper blade.
 - a. Construct linkages of galvanized or cadmium plated steel or stainless steel.
 - b. Bearings and joints shall be ball and socket or sleeve bearings of brass, bronze or stainless steel, with plated bolts and locking nuts.
 8. Seals: Provide mechanically attached elastomer or neoprene blade tip seal along the full length of each blade edge and flexible stainless steel seals along damper blade ends where the blades abut the frame. Adhesives or staples will not be acceptable.
 9. Damper Mounting: Mount dampers to casings and ductwork in conformance with SMACNA standards. Provide welded or bolted galvanized steel structural supports for dampers larger than 20 square feet. Through bolt damper frames to structural supports.
 10. Submit information showing leakage and flow characteristics, and schedule showing sizes, locations and actuators.

2.06 WIRING

- A. General: Provide a complete system of electric wiring for temperature control apparatus including control power transformers and wiring to the transformer primary.
- B. Insulation Level: Control circuit conductors which run in the same conduit as power circuit conductors shall have the same insulation level as adjacent power conductors.

- C. NFPA 70: All wiring shall conform to the requirements of the NFPA 70.
- D. Wiring: Wire for low voltage AC shall be minimum 300 volt insulated copper No. 18 AWG or larger conforming to NFPA 70, Type MTW, THHN or TFFN.
 - 1. For low voltage DC and an electronic circuit carrying less than 0.5 amperes, cables of two or more conductors not smaller than No. 18 AWG solid copper or No. 18 AWG solid copper if not shielded may be used in lieu of individual wires.
 - 2. Cables carrying analog signals shall be shielded.
 - 3. Cables shall be terminated in solder or screw type terminal strips.
 - 4. Cables shall not be tapped at any intermediate points.
 - 5. All wire shall not be color coded or numbered for identification. Identify as indicated on shop drawings and "As-Built" drawings.
 - 6. Wire terminating in screw type terminal strips shall have pressure connectors conforming to UL 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors", or UL 486B, "Wire Connectors for Use With Aluminum Conductors".
 - 7. Wire terminations without connectors or travelling pressure pads will not be accepted.

2.07 ECONOMIZER CONTROL

- A. General: Provide economizer control for all units over 5.4 tons
- B. All economizers must meet the requirements of the Advanced Buildings Core Performance Guide Criteria 2.13 – Fundamental Economizer Performance.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that duct-, pipe-, and equipment-mounted devices and wiring are installed before proceeding with installation.

3.02 INSTALLATION

- A. Install equipment level and plumb.
- B. Verify location of thermostats and other exposed control sensors with plans and room details before installation, unless otherwise indicated on the mechanical, electrical, or architectural drawings. Locate all wall mounted devices 60 inches above the floor.
- C. Install guards on thermostats in the following locations:
 - 1. Where indicated on drawings.
- D. Install damper motors on duct exterior. Do not locate operators exposed to outdoor temperatures. Arrange actuators to "Fail Safe" in the event of power failure.
- E. Install labels and nameplates to identify control components according to Section 23 05 53 (15075) - "Identification for HVAC Piping and Equipment."

3.03 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26.
- B. Install building wire and cable according to Section 26 05 19 (16120) - "Low Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Division 26.

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
4. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
5. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.
- F. All wall-mounted space sensors such as thermostats shall be securely anchored to an electrical box. Do not mount devices directly to the wall surfaces.
- G. Identification: Labor or color code each filed wire and conduit at each controller and controlled device.
 1. Identification shall be permanent and not subject to fading.
 2. Permanently mark terminal blocks at wire termination points.

3.04 FIELD QUALITY CONTROL

- A. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
- C. Replace damaged or malfunctioning controls and equipment.
 1. Start, test, and adjust control systems.
 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.05 DEMONSTRATION AND TRAINING

- A. Demonstration: Include start-up, automatic and manual operation, and emergency modes of use in accordance with the prescribed sequence of operations. Should the HVAC system demonstration fail to operate properly, the system shall be repaired, recalibrated, and retested as necessary.
- B. Train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 2. Conduct training as specified in Section 01 79 00 - "Training".

3.06 POST OCCUPANCY ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three 2-hour on-site Project visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes, adjust sensors and controls to suit actual conditions, and assist in the diagnostics of HVAC problems.

END OF SECTION

SECTION 23 09 93 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Control Sequences for HVAC Systems, Subsystems, and Equipment.
- B. Related Sections:
 - 1. Section 23 09 00 - Instrumentation and Control for HVAC.

1.02 SEQUENCES

- A. (PTAC) Package Terminal Air Conditioning Units.
 - 1. Service: As shown on the drawings.
 - 2. Wall-mounted, hard-wired thermostat shall cycle fan, reversing valve, compressor and electric heat to maintain space set point temperature.
 - 3. Remove temperature limiters.
- B. (EUH) Electric Unit Heaters.
 - 1. Service: As shown on the drawings.
 - 2. Integral thermostat shall cycle fan and resistance heat to maintain space set point temperature.
- C. (ECH) Electric Cabinet Unit Heaters
 - 1. Service: As shown on the drawings.
 - 2. Integral thermostat shall cycle resistance heating, element to maintain space set point temperature.
- D. (EWH) Electric Wall Heaters
 - 1. Service: As shown on the drawings.
 - 2. Integral thermostat shall cycle resistance heating, element to maintain space set point temperature.
- E. (EBB) Electric Baseboard Heaters
 - 1. Service: As shown on the drawings. Various areas.
 - 2. Integral thermostat shall cycle resistance heating, element to maintain space set point temperature.
- F. Janitor's Closet Exhaust.
 - 1. The contractor shall interlock exhaust fan with light switch. When the lights are turned on, the exhaust fan shall start. When the lights are turned off, the fan shall stop.
- G. Public Toilet Room Exhaust, Laundry Chute Exhaust and Guest Room Exhaust Shaft Fans.
 - 1. The exhaust fan shall run continuously, 24 hours per day.
- H. Guest Room Bathroom Exhaust.
 - 1. The contractor shall interlock exhaust fan with light switch. When the lights are turned on, the exhaust fan shall start. When the lights are turned off, the fan shall stop.

- I. Elevator Equipment Room, Mechanical Room, Pool Mechanical Room and Electrical Room Exhausts shall operate via room thermostat to maintain space temperature below setpoint.
- J. (PDU) Pool Dehumidification Unit
 - 1. Service: Pool area
 - 2. The PDU shall operate as required by manufacturer's specification and be controlled by a microprocessor supplied with PDU equipment; sequence heating, cooling and dehumidification as called for by space thermostat and humidistat and system microprocessor.
 - 3. O.A. Damper with timeclock control for occupied and unoccupied.
 - 4. Flow switch shall be interlocked with pool recirculating pumps.
 - 5. Pool Exhaust fan runs continuous.
- K. Combustion Air Louver Dampers
 - 1. Interlock with gas fired equipment to open when equipment fires up.
- L. Makeup Air Unit:
 - 1. This unit shall run continuously, 24 hours per day, and maintain discharge air setpoint.
 - 2. Fan current transducer shall generate a visual alarm when current draw from fan varies more than 10% from the expected value.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: [100 psig (690 kPa)] <Insert value> minimum unless otherwise indicated.
2. Service Regulators: [65 psig (450 kPa)] [100 psig (690 kPa)] <Insert value> minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: [0.5 psig (3.45 kPa) or less] [More than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa)] <Insert pressure range>.

C. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa), and is reduced to secondary pressure of 0.5 psig (3.45 kPa) or less.

D. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Delegated-Design Submittal: For natural-gas piping and equipment 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 seismic restraints.
 2. Design Calculations: Calculate requirements for selecting seismic restraints.
- D. Welding certificates.
- E. Field quality-control reports.
- F. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.
 - e. **<Insert manufacturer's name>**.
 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.

3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: [25] <Insert value> or less.
 - 2) Smoke-Developed Index: [50] [450] <Insert value> or less.
 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 5. Striker Plates: Steel, designed to protect tubing from penetrations.
 6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
 7. Operating-Pressure Rating: 5 psig (34.5 kPa).
- C. Annealed-Temper Copper Tube: Comply with [ASTM B 88, Type K (ASTM B 88M, Type A)] [ASTM B 88, Type L (ASTM B 88M, Type B)] [ASTM B 837, Type G].
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
 2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper fittings with long nuts.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads complying with ASME B1.20.3.
 3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch (0.56 mm) thick.
- D. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. [**Vent casing aboveground.**]
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or suitable for welded connection.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
 4. Transition Service-Line Risers: Factory fabricated and leak tested.

- a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
- b. Outlet shall be threaded or suitable for welded connection.
- c. Bridging sleeve over mechanical coupling.
- d. Factory-connected anode.
- e. Tracer wire connection.
- f. Ultraviolet shield.
- g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: **0.5 psig (3.45 kPa)**.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: **72 inches (1830 mm)**.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for **NPS 2 (DN 50)** and smaller.
3. Strainer Screen: **[40] [60]**-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: **125 psig (862 kPa)**.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
 - 1. CWP Rating: [125 psig (862 kPa)] <Insert pressure>.
 - 2. Threaded Ends: Comply with ASME B1.20.1.
 - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
 - 6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.
- C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
 - 1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 - f. <Insert manufacturer's name>.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Ball: Chrome-plated brass.
 - 4. Stem: Bronze; blowout proof.
 - 5. Seats: Reinforced TFE; blowout proof.
 - 6. Packing: Separate packnut with adjustable-stem packing threaded ends.
 - 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 8. CWP Rating: 600 psig (4140 kPa).
 - 9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 - f. **<Insert manufacturer's name>**.
 2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: **600 psig (4140 kPa)**.
 9. Listing: Valves **NPS 1 (DN 25)** and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 - f. **<Insert manufacturer's name>**.
 2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: **600 psig (4140 kPa)**.
 9. Listing: Valves **NPS 1 (DN 25)** and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.
 - c. **<Insert manufacturer's name>**.
 2. Body: Bronze, complying with ASTM B 584.
 3. Plug: Bronze.
 4. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Operator: Square head or lug type with tamperproof feature where indicated.
 6. Pressure Class: **125 psig (862 kPa)**.
 7. Listing: Valves **NPS 1 (DN 25)** and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- G. PE Ball Valves: Comply with ASME B16.40.
1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. Kerotest Manufacturing Corp.
 - b. Lyall, R. W. & Company, Inc.
 - c. Perfection Corporation; a subsidiary of American Meter Company.
 - d. **<Insert manufacturer's name>**.
 2. Body: PE.
 3. Ball: PE.
 4. Stem: Acetal.
 5. Seats and Seals: Nitrile.
 6. Ends: Plain or fusible to match piping.
 7. CWP Rating: **[80 psig (552 kPa)] <Insert pressure>**.
 8. Operating Temperature: **[Minus 20 to plus 140 deg F (Minus 29 to plus 60 deg C)] <Insert temperature range>**.
 9. Operator: Nut or flat head for key operation.
 10. Include plastic valve extension.
 11. Include tamperproof locking feature for valves where indicated on Drawings.
- H. Valve Boxes:
1. Cast-iron, two-section box.
 2. Top section with cover with "GAS" lettering.
 3. Bottom section with base to fit over valve and barrel a minimum of **5 inches (125 mm)** in diameter.
 4. Adjustable cast-iron extensions of length required for depth of bury.
 5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 MOTORIZED GAS VALVES

A. Electrically Operated Valves: Comply with UL 429.

1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. ASCO Power Technologies, LP; Division of Emerson.
 - b. Dungs, Karl, Inc.
 - c. Eclipse Combustion, Inc.
 - d. Goyen Valve Corp.; Tyco Environmental Systems.
 - e. Magnatrol Valve Corporation.
 - f. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
 - g. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - h. **<Insert manufacturer's name>**.
3. Pilot operated.
4. Body: Brass or aluminum.
5. Seats and Disc: Nitrile rubber.
6. Springs and Valve Trim: Stainless steel.
7. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
8. NEMA ICS 6, Type 4, coil enclosure.
9. Normally closed.
10. Visual position indicator.

2.6 EARTHQUAKE VALVES

A. Earthquake Valves: Comply with ASCE 25.

1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. Vanguard Valves, Inc.
 - b. **<Insert manufacturer's name>**.
3. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
4. Maximum Operating Pressure: **5 psig (34.5 kPa)**.
5. Cast-aluminum body with nickel-plated chrome steel internal parts.
6. Nitrile-rubber valve washer.
7. Sight windows for visual indication of valve position.
8. Threaded end connections complying with ASME B1.20.1.

9. Wall mounting bracket with bubble level indicator.
- B. Earthquake Valves: Comply with ASCE 25.
1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. Pacific Seismic Products, Inc.
 - b. **<Insert manufacturer's name>**.
 3. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 4. Maximum Operating Pressure: **[0.5 psig (3.45 kPa)] [7 psig (48 kPa)] [60 psig (414 kPa)]**.
 5. Cast-aluminum body with stainless-steel internal parts.
 6. Nitrile-rubber, reset-stem o-ring seal.
 7. Valve position, open or closed, indicator.
 8. Composition valve seat with clapper held by spring or magnet locking mechanism.
 9. Level indicator.
 10. End Connections: Threaded for valves **NPS 2 (DN 50)** and smaller.

2.7 PRESSURE REGULATORS

- A. General Requirements:
1. Single stage and suitable for natural gas.
 2. Steel jacket and corrosion-resistant components.
 3. Elevation compensator.
 4. End Connections: Threaded for regulators **NPS 2 (DN 50)** and smaller.
- B. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Eclipse Combustion, Inc.
 - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - e. Invensys.
 - f. Maxitrol Company.
 - g. Richards Industries; Jordan Valve Div.
 - h. **<Insert manufacturer's name>**.

3. Body and Diaphragm Case: Cast iron or die-cast aluminum.
4. Springs: Zinc-plated steel; interchangeable.
5. Diaphragm Plate: Zinc-plated steel.
6. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
7. Orifice: Aluminum; interchangeable.
8. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
9. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
10. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
11. Overpressure Protection Device: Factory mounted on pressure regulator.
12. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
13. Maximum Inlet Pressure: [2 psig (13.8 kPa)] [5 psig (34.5 kPa)] [10 psig (69 kPa)] <Insert pressure>.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
 - f. <Insert manufacturer's name>.
3. Body and Diaphragm Case: Die-cast aluminum.
4. Springs: Zinc-plated steel; interchangeable.
5. Diaphragm Plate: Zinc-plated steel.
6. Seat Disc: Nitrile rubber.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
9. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
10. Maximum Inlet Pressure: [1 psig (6.9 kPa)] [2 psig (13.8 kPa)] [5 psig (34.5 kPa)] <Insert pressure>.

2.8 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
 - i. **<Insert manufacturer's name>**.
2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: **[125 psig (860 kPa) minimum at 180 deg F (82 deg C)] [150 psig (1035 kPa)] [250 psig (1725 kPa)]**.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.9 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE 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 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 yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

- A. Comply with **[NFPA 54] [the International Fuel Gas Code]** for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least **[36 inches (900 mm)] <Insert value>** below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
 1. If natural-gas piping is installed less than **36 inches (900 mm)** below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.

2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 3. Replace pipe having damaged PE coating with new pipe.
- E. Copper Tubing with Protective Coating:
1. Apply joint cover kits over tubing to cover, seal, and protect joints.
 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- F. Install fittings for changes in direction and branch connections.
- G. Install pressure gage [**downstream**] [**upstream and downstream**] from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.2 INDOOR PIPING INSTALLATION

- A. Comply with [**NFPA 54**] [**the International Fuel Gas Code**] for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than **3 inches (75 mm)** long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- Q. Connect branch piping from top or side of horizontal piping.
- R. Install unions in pipes **NPS 2 (DN 50)** and smaller, adjacent to each valve, at final connection to each piece of equipment.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- U. Install pressure gage [**downstream**] [**upstream and downstream**] from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.3 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. 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.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

- B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
 - 2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
- D. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).
 - 2. NPS 1/2 (DN 15): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
 - 3. NPS 3/4 (DN 20) and Larger: Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

3.6 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to [NFPA 54] [the **International Fuel Gas Code**] and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be[**one of**] the following:
 - 1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
 - 2. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
 - 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
- B. Aboveground natural-gas piping shall be[**one of**] the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
 - 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
- C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and [**brazed**] [**flared**] joints. Install piping embedded in concrete with no joints in concrete.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.10 INDOOR PIPING SCHEDULE

- A. Aboveground, branch piping [**NPS 1 (DN 25)**] <Insert pipe size> and smaller shall be[**one of**] the following:
 - 1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
 - 2. Annealed-temper copper tube with wrought-copper fittings and [**brazed**] [**flared**] joints.
 - 3. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be[**one of**] the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- C. Underground, below building, piping shall be[**one of**] the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
 2. Steel pipe with wrought-steel fittings and welded joints.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.11 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
- B. Underground: **[PE] [Bronze plug]** valves.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes **NPS 2 (DN 50)** and smaller at service meter shall be **[one of]** the following:
1. One-piece, bronze ball valve with bronze trim.
 2. Two-piece, **[full] [regular]**-port, bronze ball valves with bronze trim.
 3. Bronze plug valve.
- B. Distribution piping valves for pipe sizes **NPS 2 (DN 50)** and smaller shall be **[one of]** the following:
1. One-piece, bronze ball valve with bronze trim.
 2. Two-piece, **[full] [regular]**-port, bronze ball valves with bronze trim.
 3. Bronze plug valve.
- C. Valves in branch piping for single appliance shall be **[one of]** the following:
1. One-piece, bronze ball valve with bronze trim.
 2. Two-piece, **[full] [regular]**-port, bronze ball valves with bronze trim.
 3. Bronze plug valve.

END OF SECTION 231123

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Condenser-water piping.
 - 4. Makeup-water piping.
 - 5. Condensate-drain piping.
 - 6. Blowdown-drain piping.
 - 7. Air-vent piping.
 - 8. Safety-valve-inlet and -outlet piping.
- B. See Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.2 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Hot-Water Heating Piping: <Insert psig (kPa)> at [200 deg F (93 deg C)] <Insert temperature>.
 - 2. Chilled-Water Piping: <Insert psig (kPa)> at [200 deg F (93 deg C)] <Insert temperature>.
 - 3. Condenser-Water Piping: <Insert psig (kPa)> at [150 deg F (66 deg C)] <Insert temperature>.
 - 4. Makeup-Water Piping: [80 psig (552 kPa)] <Insert pressure> at [150 deg F (66 deg C)] <Insert temperature>.
 - 5. Condensate-Drain Piping: [150 deg F (66 deg C)] <Insert temperature>.
 - 6. Blowdown-Drain Piping: [200 deg F (93 deg C)] <Insert temperature>.
 - 7. Air-Vent Piping: [200 deg F (93 deg C)] <Insert temperature>.
 - 8. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.3 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Plastic pipe and fittings with solvent cement.
 - 2. Pressure-seal fittings.

3. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
4. Air control devices.
5. Chemical treatment.
6. Hydronic specialties.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Detail, at [1/4 (1:50)] <Insert scale> scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

D. Field quality-control test reports.

E. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: [ASTM B 88, Type L (ASTM B 88M, Type B)] [ASTM B 88, Type M (ASTM B 88M, Type C)].
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Fittings: ASME B16.22.
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:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company.
 - d. <Insert manufacturer's name.>
 4. Grooved-End Copper Fittings: **ASTM B 75** (**ASTM B 75M**), copper tube or ASTM B 584, bronze casting.
 5. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, [**prelubricated**] EPDM gasket rated for minimum **230 deg F** (**110 deg C**) for use with housing, and steel bolts and nuts.
- E. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.
- F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 1. Material Group: 1.1.
 2. End Connections: Butt welding.
 3. Facings: Raised face.
- G. Grooved Mechanical-Joint Fittings and Couplings:
 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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or a comparable product by one of the following:
 - a. Anvil International, Inc.
 - b. Central Sprinkler Company; a division of Tyco Fire & Building Products.
 - c. National Fittings, Inc.
 - d. S. P. Fittings; a division of Star Pipe Products.
 - e. Victaulic Company.
 - f. <**Insert manufacturer's name.**>
4. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
5. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.3 PLASTIC PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.
- C. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- D. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- F. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - a. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. 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).
 - c. Solvent cement and 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," including 2004 Addenda.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - a. 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).
 - b. 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).
 - c. Solvent cement and 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," including 2004 Addenda.
- G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
 - 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. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBi.
 - d. <Insert manufacturer's name.>

3. [CPVC] [PVC] [CPVC and PVC] one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions:

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. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBi.
 - d. NIBCO INC.
 - e. <Insert manufacturer's name.>
3. MSS SP-107, [CPVC] [PVC] [CPVC and PVC] union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
 - i. <Insert manufacturer's name>.
2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: [125 psig (860 kPa) minimum at 180 deg F (82 deg C)] [150 psig (1035 kPa)] [250 psig (1725 kPa)].
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.7 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."
- C. Bronze, Calibrated-Orifice, Balancing Valves:
 - 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:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide **[the product indicated on Drawings]** <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
 - g. Tour & Andersson; available through Victaulic Company.
 - h. <Insert manufacturer's name.>
 - 4. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - 5. Ball: Brass or stainless steel.
 - 6. Plug: Resin.
 - 7. Seat: PTFE.
 - 8. End Connections: Threaded or socket.
 - 9. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 10. Handle Style: Lever, with memory stop to retain set position.
 - 11. CWP Rating: Minimum **125 psig (860 kPa)**.
 - 12. Maximum Operating Temperature: **250 deg F (121 deg C)**.
- D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
 - 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:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide **[the product indicated on Drawings]** <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.

- c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
 - g. **<Insert manufacturer's name.>**
- 4. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 - 5. Ball: Brass or stainless steel.
 - 6. Stem Seals: EPDM O-rings.
 - 7. Disc: Glass and carbon-filled PTFE.
 - 8. Seat: PTFE.
 - 9. End Connections: Flanged or grooved.
 - 10. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 11. Handle Style: Lever, with memory stop to retain set position.
 - 12. CWP Rating: Minimum **125 psig (860 kPa)**.
 - 13. Maximum Operating Temperature: **250 deg F (121 deg C)**.
- E. Diaphragm-Operated, Pressure-Reducing Valves:
- 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:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide **[the product indicated on Drawings]** **<Insert manufacturer's name; product name or designation>** or a comparable product by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - g. **<Insert manufacturer's name.>**
 - 4. Body: Bronze or brass.
 - 5. Disc: Glass and carbon-filled PTFE.
 - 6. Seat: Brass.
 - 7. Stem Seals: EPDM O-rings.
 - 8. Diaphragm: EPT.
 - 9. Low inlet-pressure check valve.
 - 10. Inlet Strainer: **<Insert materials>**, removable without system shutdown.
 - 11. Valve Seat and Stem: Noncorrosive.
 - 12. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
- F. Diaphragm-Operated Safety Valves:

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or a comparable product by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - g. <**Insert manufacturer's name.**>
4. Body: Bronze or brass.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: Brass.
7. Stem Seals: EPDM O-rings.
8. Diaphragm: EPT.
9. Wetted, Internal Work Parts: Brass and rubber.
10. Inlet Strainer: <**Insert materials**>, removable without system shutdown.
11. Valve Seat and Stem: Noncorrosive.
12. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Automatic Flow-Control Valves:

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or a comparable product by one of the following:
 - a. Flow Design Inc.
 - b. Griswold Controls.
 - c. <**Insert manufacturer's name.**>
4. Body: Brass or ferrous metal.
5. Piston and Spring Assembly: [**Stainless steel**] [**Corrosion resistant**], tamper proof, self cleaning, and removable.
6. Combination Assemblies: Include bronze or brass-alloy ball valve.
7. Identification Tag: Marked with zone identification, valve number, and flow rate.
8. Size: Same as pipe in which installed.

9. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
10. Minimum CWP Rating: [175 psig (1207 kPa)] [300 psig (2070 kPa)].
11. Maximum Operating Temperature: [200 deg F (93 deg C)] [250 deg F (121 deg C)].

2.8 AIR CONTROL DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amtrol, Inc.
 2. Armstrong Pumps, Inc.
 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
 4. Taco.
 5. **<Insert manufacturer's name.>**
- C. Manual Air Vents:
 1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Screwdriver or thumbscrew.
 4. Inlet Connection: **NPS 1/2 (DN 15)**.
 5. Discharge Connection: **NPS 1/8 (DN 6)**.
 6. CWP Rating: **150 psig (1035 kPa)**.
 7. Maximum Operating Temperature: **225 deg F (107 deg C)**.
- D. Expansion Tanks:
 1. Tank: Welded steel, rated for **125-psig (860-kPa)** working pressure and **375 deg F (191 deg C)** maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, **100-gal. (379-L)** unit only; sized for compression-tank diameter. Provide tank fittings for **125-psig (860-kPa)** working pressure and **250 deg F (121 deg C)** maximum operating temperature.
 3. Tank Drain Fitting: Brass body, nonferrous internal parts; **125-psig (860-kPa)** working pressure and **240 deg F (116 deg C)** maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
 4. Gage Glass: Full height with dual manual shutoff valves, **[3/4-inch- (20-mm-)]** **<Insert dimension>** diameter gage glass, and slotted-metal glass guard.
- E. In-Line Air Separators:
 1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
 2. Maximum Working Pressure: Up to **175 psig (1207 kPa)**.

3. Maximum Operating Temperature: Up to 300 deg F (149 deg C).

2.9 CHEMICAL TREATMENT

- A. Bypass Chemical Feeder: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves.
 1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.
- B. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

2.10 HYDRONIC PIPING SPECIALTIES

- A. Y-Pattern Strainers:
 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
 3. Strainer Screen: [40] [60]-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig (860 kPa).
- B. Stainless-Steel Bellow, Flexible Connectors:
 1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
 2. End Connections: Threaded or flanged to match equipment connected.
 3. Performance: Capable of 3/4-inch (20-mm) misalignment.
 4. CWP Rating: 150 psig (1035 kPa).
 5. Maximum Operating Temperature: 250 deg F (121 deg C).
- C. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, [NPS 2 (DN 50) and smaller,] <Insert pipe size range> shall be[any of] the following:
 1. Type [L (B)] [M (C)], drawn-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] [pressure-seal] joints.

2. Schedule [40] [30] [20] steel pipe; Class [125, cast-iron] [150, malleable-iron] [250, cast-iron] [300, malleable-iron] fittings; cast-iron flanges and flange fittings; and threaded joints.
 3. Schedule [40] [80] CPVC plastic pipe and fittings and solvent-welded joints.
- B. Hot-water heating piping, aboveground, [NPS 2-1/2 (DN 65) and larger,] <Insert pipe size range> shall be[any of] the following:
1. Type [L (B)] [M (C)], drawn-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] joints.
 2. Schedule [40] [30] [20] steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 3. Schedule [40] [30] [20] steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
 4. Schedule [40] [80] CPVC plastic pipe and fittings and solvent-welded joints.
- C. Hot-Water Heating Piping Installed Belowground and within Slabs: Type K (A), annealed-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] joints. Use the fewest possible joints.
- D. Chilled-water piping, aboveground, [NPS 2 (DN 50) and smaller,] <Insert pipe size range> shall be[any of] the following:
1. Type [L (B)] [M (C)], drawn-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] [pressure-seal] joints.
 2. Schedule [40] [30] [20] steel pipe; Class [125, cast-iron] [150, malleable-iron] [250, cast-iron] [300, malleable-iron] fittings; cast-iron flanges and flange fittings; and threaded joints.
 3. Schedule [40] [80] CPVC plastic pipe and fittings and solvent-welded joints.
- E. Chilled-water piping, aboveground, [NPS 2-1/2 (DN 65) and larger,] <Insert pipe size range> shall be[any of] the following:
1. Type [L (B)] [M (C)], drawn-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] joints.
 2. Schedule [40] [30] [20] steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 3. Schedule [40] [30] [20] steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
 4. Schedule [40] [80] CPVC plastic pipe and fittings and solvent-welded joints.
- F. Chilled-Water Piping Installed Belowground and within Slabs: Type K (A), annealed-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] joints. Use the fewest possible joints.
- G. Condenser-water piping, aboveground, [NPS 2 (DN 50) and smaller,] <Insert pipe size range> shall be[any of] the following:
1. Type [L (B)] [M (C)], drawn-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] [pressure-seal] joints.

2. Schedule [80] [40] [30] [20] steel pipe; Class [125, cast-iron] [150, malleable-iron] [250, cast-iron] [300, malleable-iron] fittings; cast-iron flanges and flange fittings; and threaded joints.
 3. Schedule [40] [80] CPVC plastic pipe and fittings and solvent-welded joints.
- H. Condenser-water piping, aboveground, [NPS 2-1/2 (DN 65) and larger,] <Insert pipe size range> shall be[any of] the following:
1. Type [L (B)] [M (C)], drawn-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] joints.
 2. Schedule [80] [40] [30] [20] steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 3. Schedule [80] [40] [30] [20] steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
 4. Schedule [40] [80] CPVC plastic pipe and fittings and solvent-welded joints.
- I. Condenser-Water Piping Installed Belowground and within Slabs: Type K (A), annealed-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] joints. Use the fewest possible joints.
- J. Makeup-water piping installed aboveground shall be[either of] the following:
1. Type [L (B)] [M (C)], drawn-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] joints.
 2. Schedule [40] [80] CPVC plastic pipe and fittings, and solvent-welded joints.
- K. Makeup-Water Piping Installed Belowground and within Slabs: Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- L. Condensate-Drain Piping: Type [M (C)] [DWV], drawn-temper copper tubing, wrought-copper fittings, and soldered joints[or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints].
- M. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
- N. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- O. Air-Vent Piping:
1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
 2. Outlet: Type K (A), annealed-temper copper tubing with soldered or flared joints.
- P. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install [**throttling-duty**] [**calibrated-orifice, balancing**] valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

- L. Install drains, consisting of a tee fitting, **NPS 3/4 (DN 20)** ball valve, and short **NPS 3/4 (DN 20)** threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using [**mechanically formed**] tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, **NPS 2 (DN 50)** and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, **NPS 2-1/2 (DN 65)** and larger, at final connections of equipment and elsewhere as indicated.
- S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install **NPS 3/4 (DN 20)** nipple and ball valve in blowdown connection of strainers **NPS 2 (DN 50)** and larger. Match size of strainer blowoff connection for strainers smaller than **NPS 2 (DN 50)**.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
- U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).
7. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

G. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- I. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- J. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- C. Install in-line air separators in pump suction. Install drain valve on air separators **NPS 2 (DN 50)** and larger.

- D. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than **48 inches (1200 mm)** above the floor. Install feeder in minimum **NPS 3/4 (DN 20)** bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install **NPS 3/4 (DN 20)** pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
- E. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - 1. Install tank fittings that are shipped loose.
 - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 CHEMICAL TREATMENT

- A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.
- C. Fill systems indicated to have antifreeze or glycol solutions with the following concentrations:
 - 1. Hot-Water Heating Piping: Minimum **<Insert number>** percent **[ethylene]** **[propylene]** glycol.
 - 2. Chilled-Water Heating Piping: Minimum **<Insert number>** percent **[ethylene]** **[propylene]** glycol.

3.9 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Close-coupled, end-suction centrifugal pumps.
3. Separately coupled, horizontally mounted, in-line centrifugal pumps.
4. Separately coupled, vertically mounted, in-line centrifugal pumps.
5. Separately coupled, base-mounted, end-suction centrifugal pumps.
6. Automatic condensate pump units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of pump.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, **[provide products by the following]** **[provide products by one of the following]** **[available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**

B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:

1. Armstrong Pumps Inc.
2. Aurora Pump; Division of Pentair Pump Group.
3. Crane Pumps & Systems.

4. Flowserve Corporation.
 5. Grundfos Pumps Corporation.
 6. ITT Corporation; Bell & Gossett.
 7. Mepco, LLC.
 8. PACO Pumps.
 9. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.
 10. Peerless Pump Company.
 11. TACO Incorporated.
 12. Thrush Company Inc.
 13. **<Insert manufacturer's name>**.
- C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
- D. Pump Construction:
1. Casing: Radially split, cast iron, with threaded gage tapings at inlet and outlet[, **replaceable bronze wear rings**,] and threaded [**companion-flange**] [**union-end**] connections.
 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
 3. Pump Shaft: [**Steel, with copper-alloy shaft sleeve**] [**Stainless steel**].
 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and [**Buna-N**] [**EPT**] bellows and gasket. Include water slinger on shaft between motor and seal.
 5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 6. Pump Bearings: [**Permanently lubricated ball bearings**] [**Oil lubricated; bronze-journal or thrust type**].
- E. Motor: Single speed and rigidly mounted to pump casing.
1. 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. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - a. Enclosure: [**Open, dripproof**] [**Totally enclosed, fan cooled**] [**Totally enclosed, air over**] [**Open, externally ventilated**] [**Totally enclosed, nonventilated**] [**Severe duty**] [**Explosion proof**] [**Dust-ignition-proof machine**].
 - b. Enclosure Materials: [**Cast iron**] [**Cast aluminum**] [**Rolled steel**].
 - c. Motor Bearings: [**Permanently lubricated**] [**Grease-lubricated**] ball bearings.
 - d. Unusual Service Conditions:
 - 1) Ambient Temperature: **<Insert deg C>**.
 - 2) Altitude: **<Insert feet (meters)>** above sea level.

- 3) High humidity.
- 4) **<Insert conditions>**.

- e. Efficiency: Premium efficient.
- f. NEMA Design: **<Insert designation>**.
- g. Service Factor: **<Insert value>**.

F. Capacities and Characteristics:

1. Capacity: **<Insert gpm (L/s)>**.
2. Total Dynamic Head: **<Insert feet (kPa)>**.
3. Maximum Operating Pressure: **[175 psig (1204 kPa)] [250 psig (1720 kPa)]**.
4. Maximum Continuous Operating Temperature: **[225 deg F (107 deg C)] [250 deg F (120 deg C)]**.
5. Inlet and Outlet Size: **<Insert NPS (DN)>**.
6. Impeller Size: **<Insert inches (mm)>**.
7. Motor Speed: **<Insert rpm>**.
8. Motor Horsepower: **<Insert value>**.
9. Electrical Characteristics:
 - a. Volts: **[120] [240] [208] [460] <Insert value>**.
 - b. Phase: **[Single] [Three]**.
 - c. Hertz: 60.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.

2.2 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]**:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:

1. American-Marsh Pumps.
2. Armstrong Pumps Inc.
3. Aurora Pump; Division of Pentair Pump Group.
4. Buffalo Pumps, Inc.
5. Crane Pumps & Systems.
6. Flowserve Corporation.
7. ITT Corporation; Bell & Gossett.
8. ITT Corporation; Goulds Pumps.
9. Lancaster Pump.
10. Mepco, LLC.
11. PACO Pumps.
12. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.
13. Peerless Pump Company.

14. Scot Pump; Div. of Ardox Corp.
 15. TACO Incorporated.
 16. Thrush Company Inc.
 17. **<Insert manufacturer's name>**.
- C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.
- D. Pump Construction:
1. Casing: Radially split, cast iron, with[**replaceable bronze wear rings,**] drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and [**threaded companion-flange**] [**flanged**] connections.
 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
 3. Pump Shaft: [**Steel, with copper-alloy shaft sleeve**] [**Stainless steel**].
 4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and [**Buna-N**] [**EPT**] bellows and gasket. Include water slinger on shaft between motor and seal.
 5. Pump Bearings: [**Permanently lubricated ball bearings**] [**Oil lubricated; bronze-journal or thrust type**].
- E. Motor: Single speed and rigidly mounted to pump casing with integral pump support.
1. 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. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - a. Enclosure: [**Open, dripproof**] [**Totally enclosed, fan cooled**] [**Totally enclosed, air over**] [**Open, externally ventilated**] [**Totally enclosed, nonventilated**] [**Severe duty**] [**Explosion proof**] [**Dust-ignition-proof machine**].
 - b. Enclosure Materials: [**Cast iron**] [**Cast aluminum**] [**Rolled steel**].
 - c. Motor Bearings: [**Permanently lubricated**] [**Grease-lubricated**] ball bearings.
 - d. Unusual Service Conditions:
 - 1) Ambient Temperature: **<Insert deg C>**.
 - 2) Altitude: **<Insert feet (meters)>** above sea level.
 - 3) High humidity.
 - 4) **<Insert conditions>**.
 - e. Efficiency: Premium efficient.
 - f. NEMA Design: **<Insert designation>**.
 - g. Service Factor: **<Insert value>**.
- F. Capacities and Characteristics:

1. Capacity: <Insert **gpm (L/s)**>.
2. Total Dynamic Head: <Insert **feet (kPa)**>.
3. Maximum Operating Pressure: **175 psig (1204 kPa)**.
4. Maximum Continuous Operating Temperature: [**225 deg F (107 deg C)**] [**250 deg F (120 deg C)**].
5. Inlet and Outlet Size: <Insert **NPS (DN)**>.
6. Impeller Size: <Insert **inches (mm)**>.
7. Motor Speed: <Insert **rpm**>.
8. Motor Horsepower: <Insert **value**>.
9. Electrical Characteristics:
 - a. Volts: [**120**] [**240**] [**208**] [**460**] <Insert **value**>.
 - b. Phase: [**Single**] [**Three**].
 - c. Hertz: 60.
 - d. Full-Load Amperes: <Insert **value**>.
 - e. Minimum Circuit Ampacity: <Insert **value**>.
 - f. Maximum Overcurrent Protection: <Insert **amperage**>.

2.3 SEPARATELY COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <Insert **manufacturer's name; product name or designation**> or comparable product by one of the following:
 1. Armstrong Pumps Inc.
 2. Aurora Pump; Division of Pentair Pump Group.
 3. Flowserve Corporation.
 4. Grundfos Pumps Corporation.
 5. ITT Corporation; Bell & Gossett.
 6. Mepco, LLC.
 7. PACO Pumps.
 8. Scot Pump; Div. of Ardox Corp.
 9. TACO Incorporated.
 10. Thrush Company Inc.
 11. <Insert **manufacturer's name**>.
- C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.
- D. Pump Construction:
 1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and threaded [**companion-flange**] [**union-end**] connections.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. For pumps not frequency-drive controlled, trim impeller to match specified performance.
 3. Pump Shaft: **[Steel, with copper-alloy shaft sleeve]** **[Stainless steel]**.
 4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and **[Buna-N]** **[EPT]** bellows and gasket. Include water slinger on shaft between motor and seal.
 5. Pump Bearings: **[Permanently lubricated ball bearings]** **[Oil lubricated; bronze-journal or thrust type]**.
- E. Shaft Coupling: **[Molded-rubber insert with interlocking spider]** **[Interlocking frame with interconnecting springs]** capable of absorbing vibration.
- F. Motor: Single speed and **[resiliently]** **[rigidly]** mounted to pump casing.
1. 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. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- a. Enclosure: **[Open, dripproof]** **[Totally enclosed, fan cooled]** **[Totally enclosed, air over]** **[Open, externally ventilated]** **[Totally enclosed, nonventilated]** **[Severe duty]** **[Explosion proof]** **[Dust-ignition-proof machine]**.
 - b. Enclosure Materials: **[Cast iron]** **[Cast aluminum]** **[Rolled steel]**.
 - c. Motor Bearings: **[Permanently lubricated]** **[Grease-lubricated]** ball bearings.
 - d. Unusual Service Conditions:
 - 1) Ambient Temperature: **<Insert deg C>**.
 - 2) Altitude: **<Insert feet (meters)>** above sea level.
 - 3) High humidity.
 - 4) **<Insert conditions>**.
 - e. Efficiency: Premium efficient.
 - f. NEMA Design: **<Insert designation>**.
 - g. Service Factor: **<Insert value>**.
- G. Capacities and Characteristics:
1. Capacity: **<Insert gpm (L/s)>**.
 2. Total Dynamic Head: **<Insert feet (kPa)>**.
 3. Maximum Operating Pressure: **175 psig (1204 kPa)**.
 4. Maximum Continuous Operating Temperature: **[225 deg F (107 deg C)]** **[250 deg F (120 deg C)]**.
 5. Inlet and Outlet Size: **<Insert NPS (DN)>**.
 6. Impeller Size: **<Insert inches (mm)>**.
 7. Motor Speed: **<Insert rpm>**.
 8. Motor Horsepower: **<Insert value>**.
 9. Electrical Characteristics:

- a. Volts: [120] [240] [208] [460] <Insert value>.
- b. Phase: [Single] [Three].
- c. Hertz: 60.
- d. Full-Load Amperes: <Insert value>.
- e. Minimum Circuit Ampacity: <Insert value>.
- f. Maximum Overcurrent Protection: <Insert amperage>.

2.4 SEPARATELY COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 1. Armstrong Pumps Inc.
 2. Aurora Pump; Division of Pentair Pump Group.
 3. Crane Pumps & Systems.
 4. Flowserve Corporation.
 5. ITT Corporation; Bell & Gossett.
 6. Mepco, LLC.
 7. PACO Pumps.
 8. Peerless Pump Company.
 9. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.
 10. TACO Incorporated.
 11. Thrush Company Inc.
 12. <Insert manufacturer's name>.
- C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically.
- D. Pump Construction:
 1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet[, replaceable bronze wear rings,] and threaded [companion-flange] [union-end] connections.
 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
 3. Pump Shaft: [Steel, with copper-alloy shaft sleeve] [Stainless steel].
 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and [Buna-N] [EPT] bellows and gasket. Include water slinger on shaft between motor and seal.
 5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.

6. Pump Bearings: [**Permanently lubricated ball bearings**] [**Oil lubricated; bronze-journal or thrust type**].
- E. Shaft Coupling: Axially split spacer coupling.
- F. Motor: Single speed and rigidly mounted to pump casing with lifting eyebolt and supporting lugs in motor enclosure.
 1. 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. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - a. Enclosure: [**Open, dripproof**] [**Totally enclosed, fan cooled**] [**Totally enclosed, air over**] [**Open, externally ventilated**] [**Totally enclosed, nonventilated**] [**Severe duty**] [**Explosion proof**] [**Dust-ignition-proof machine**].
 - b. Enclosure Materials: [**Cast iron**] [**Cast aluminum**] [**Rolled steel**].
 - c. Motor Bearings: [**Permanently lubricated**] [**Grease-lubricated**] ball bearings.
 - d. Unusual Service Conditions:
 - 1) Ambient Temperature: **<Insert deg C>**.
 - 2) Altitude: **<Insert feet (meters)>** above sea level.
 - 3) High humidity.
 - 4) **<Insert conditions>**.
 - e. Efficiency: Premium efficient.
 - f. NEMA Design: **<Insert designation>**.
 - g. Service Factor: **<Insert value>**.
- G. Capacities and Characteristics:
 1. Capacity: **<Insert gpm (L/s)>**.
 2. Total Dynamic Head: **<Insert feet (kPa)>**.
 3. Maximum Operating Pressure: [**175 psig (1204 kPa)**] [**250 psig (1720 kPa)**].
 4. Maximum Continuous Operating Temperature: [**225 deg F (107 deg C)**] [**250 deg F (120 deg C)**].
 5. Inlet and Outlet Size: **<Insert NPS (DN)>**.
 6. Impeller Size: **<Insert inches (mm)>**.
 7. Motor Speed: **<Insert rpm>**.
 8. Motor Horsepower: **<Insert value>**.
 9. Electrical Characteristics:
 - a. Volts: [**120**] [**240**] [**208**] [**460**] **<Insert value>**.
 - b. Phase: [**Single**] [**Three**].
 - c. Hertz: 60.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.

2.5 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by the following]** **[provide products by one of the following]** **[available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
1. American-Marsh Pumps.
 2. Armstrong Pumps Inc.
 3. Aurora Pump; Division of Pentair Pump Group.
 4. Buffalo Pumps, Inc.
 5. Crane Pumps & Systems.
 6. Flowserve Corporation.
 7. ITT Corporation; Bell & Gossett.
 8. Mepco, LLC.
 9. PACO Pumps.
 10. Peerless Pump Company.
 11. Scot Pump; Div. of Ardox Corp.
 12. TACO Incorporated.
 13. Thrush Company Inc.
 14. **<Insert manufacturer's name>**.
- C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.
- D. Pump Construction:
1. Casing: Radially split, cast iron, with **[replaceable bronze wear rings,]** threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and **[threaded companion-flange]** **[flanged]** connections. **[Provide integral mount on volute to support the casing, and provide attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.]**
 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
 3. Pump Shaft: **[Steel, with copper-alloy shaft sleeve]** **[Stainless steel]**.
 4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and **[Buna-N]** **[EPT]** bellows and gasket.
 5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 6. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.
- E. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. **[Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor.]** **[EPDM coupling sleeve for variable-speed applications.]**

- F. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
- G. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
- H. Motor: Single speed, secured to mounting frame, with adjustable alignment.
 - 1. 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. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - a. Enclosure: [**Open, dripproof**] [**Totally enclosed, fan cooled**] [**Totally enclosed, air over**] [**Open, externally ventilated**] [**Totally enclosed, nonventilated**] [**Severe duty**] [**Explosion proof**] [**Dust-ignition-proof machine**].
 - b. Enclosure Materials: [**Cast iron**] [**Cast aluminum**] [**Rolled steel**].
 - c. Motor Bearings: [**Permanently lubricated**] [**Grease-lubricated**] ball bearings.
 - d. Unusual Service Conditions:
 - 1) Ambient Temperature: **<Insert deg C>**.
 - 2) Altitude: **<Insert feet (meters)>** above sea level.
 - 3) High humidity.
 - 4) **<Insert conditions>**.
 - e. Efficiency: Premium efficient.
 - f. NEMA Design: **<Insert designation>**.
 - g. Service Factor: **<Insert value>**.
- I. Capacities and Characteristics:
 - 1. Capacity: **<Insert gpm (L/s)>**.
 - 2. Total Dynamic Head: **<Insert feet (kPa)>**.
 - 3. Maximum Operating Pressure: [**175 psig (1204 kPa)**] [**250 psig (1720 kPa)**].
 - 4. Maximum Continuous Operating Temperature: [**225 deg F (107 deg C)**] [**250 deg F (120 deg C)**].
 - 5. Inlet and Outlet Size: **<Insert NPS (DN)>**.
 - 6. Impeller Size: **<Insert inches (mm)>**.
 - 7. Motor Speed: **<Insert rpm>**.
 - 8. Motor Horsepower: **<Insert value>**.
 - 9. Electrical Characteristics:
 - a. Volts: [**120**] [**240**] [**208**] [**460**] **<Insert value>**.
 - b. Phase: [**Single**] [**Three**].
 - c. Hertz: 60.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.

2.6 AUTOMATIC CONDENSATE PUMP UNITS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by the following]** **[provide products by one of the following]** **[available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
1. Beckett Corporation.
 2. Hartell Pumps Div.; Milton Roy Co.
 3. Little Giant Pump Co.
 4. Mepco, LLC.
 5. **<Insert manufacturer's name>**.
- C. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a **72-inch- (1800-mm-)** minimum, electrical power cord with plug.
- D. Capacities and Characteristics:
1. Capacity: **<Insert gpm (L/s)>**.
 2. Total Dynamic Head: **<Insert feet (kPa)>**.
 3. Maximum Height to Inlet: **<Insert inches (mm)>**.
 4. Inlet and Outlet Size: **<Insert NPS (DN)>**.
 5. Motor Speed: **<Insert rpm>**.
 6. Motor Horsepower: **<Insert value>**.
 7. Electrical Characteristics:
 - a. Volts: **[120] <Insert value>**.
 - b. Phase: Single.
 - c. Hertz: 60.
 - d. Full-Load Amperes: **<Insert value>**.
 - e. Minimum Circuit Ampacity: **<Insert value>**.
 - f. Maximum Overcurrent Protection: **<Insert amperage>**.

2.7 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser:
1. Angle pattern.
 2. **[175-psig (1204-kPa)] [300-psig (2060-kPa)]** pressure rating, **[cast] [ductile]-iron** body and end cap, pump-inlet fitting.
 3. Bronze startup and bronze or stainless-steel permanent strainers.
 4. Bronze or stainless-steel straightening vanes.
 5. Drain plug.
 6. Factory-fabricated support.
- B. Triple-Duty Valve:

1. Angle or straight pattern.
2. [175-psig (1204-kPa)] [300-psig (2060-kPa)] pressure rating, [cast] [ductile]-iron body, pump-discharge fitting.
3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- E. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases specified in Division 03 Section "[Cast-in-Place Concrete] [Miscellaneous Cast-in-Place Concrete]."
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct bases to withstand, without damage to equipment, seismic force required by code.
 3. Construct concrete bases [4 inches (100 mm)] [6 inches (150 mm)] [8 inches (200 mm)] <Insert dimension> high and extend base not less than 6 inches (150 mm) in all directions beyond the maximum dimensions of base-mounted pumps unless otherwise indicated or unless required for seismic-anchor support.
 4. Minimum Compressive Strength: [5000 psi (34.5 MPa)] [4500 psi (31 MPa)] [4000 psi (27.6 MPa)] [3500 psi (24.1 MPa)] [3000 psi (20.7 MPa)] <Insert strength> at 28 days.
- F. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment base(s) using [elastomeric pads] [elastomeric mounts] [restrained spring isolators] <Insert device>. Comply with requirements for equipment bases specified in Division 03 Section "[Cast-in-Place Concrete] [Miscellaneous Cast-in-Place Concrete]."
Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 1. Minimum Deflection: [1/4 inch (6 mm)] [1 inch (25 mm)] <Insert dimension>.
 2. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of concrete base.

4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 6. Install anchor bolts to elevations required for proper attachment to supported equipment.
 7. Install on [~~4-inch- (100-mm-)~~] [~~6-inch- (150-mm-)~~] **<Insert thickness>** high concrete base[**designed to withstand, without damage to equipment, seismic force required by code**].
- G. Equipment Mounting: Install base-mounted pumps using [**elastomeric pads**] [**elastomeric mounts**] [**restrained spring isolators**] **<Insert device>**. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
1. Minimum Deflection: [~~1/4 inch (6 mm)~~] [~~1 inch (25 mm)~~] **<Insert dimension>**.
- H. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and [**elastomeric hangers**] [**spring hangers**] [**spring hangers with vertical-limit stop**] of size required to support weight of in-line pumps.
1. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 2. Comply with requirements for hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

3.2 ALIGNMENT

- A. [**Engage a factory-authorized service representative to perform**] [**Perform**] alignment service.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Division 23 Section "Steam and Condensate Heating Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install [**check, shutoff, and throttling valves**] [**check valve and throttling valve with memory stop**] [**triple-duty valve**] on discharge side of pumps.
- F. Install [**Y-type strainer**] [**suction diffuser**] and shutoff valve on suction side of pumps.
- G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- I. Install check valve and gate or ball valve on each condensate pump unit discharge.
- J. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- K. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 232123

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-22:
 - 1. Suction Lines for Air-Conditioning Applications: 185 psig (1276 kPa).
 - 2. Suction Lines for Heat-Pump Applications: 325 psig (2241 kPa).
 - 3. Hot-Gas and Liquid Lines: 325 psig (2241 kPa).

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: [**ASTM B 88, Type K or L (ASTM B 88M, Type A or B)**] [**ASTM B 280, Type ACR**].
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum **3/4-inch (20-mm)** misalignment in minimum **7-inch- (180-mm-)** long assembly.
 - 4. Pressure Rating: Factory test at minimum **500 psig (3450 kPa)**.
 - 5. Maximum Operating Temperature: **250 deg F (121 deg C)**.

2.2 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 - 3. Operator: Rising stem and hand wheel.
 - 4. Seat: Nylon.
 - 5. End Connections: Socket, union, or flanged.
 - 6. Working Pressure Rating: **500 psig (3450 kPa)**.
 - 7. Maximum Operating Temperature: **275 deg F (135 deg C)**.
- B. Packed-Angle Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze.
 - 2. Packing: Molded stem, back seating, and replaceable under pressure.

3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275 deg F (135 deg C).

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 275 deg F (135 deg C).

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3450 kPa).

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and [24] [115] [208]-V ac coil.
6. Working Pressure Rating: 400 psig (2760 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig (2760 kPa).
6. Maximum Operating Temperature: 240 deg F (116 deg C).

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: [40 deg F (4.4 deg C)] <Insert temperature>.
6. Superheat: [Adjustable] [Nonadjustable].
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: [700 psig (4820 kPa)] [450 psig (3100 kPa)] <Insert value>.

H. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig (3450 kPa).
5. Maximum Operating Temperature: 275 deg F (135 deg C).

I. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig (3450 kPa).
6. Maximum Operating Temperature: 275 deg F (135 deg C).

J. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

K. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated [alumina] [charcoal].
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: [2 psig (14 kPa)] <Insert value>.
8. Rated Flow: <Insert tons (kW)>.
9. Working Pressure Rating: 500 psig (3450 kPa).

10. Maximum Operating Temperature: 240 deg F (116 deg C).
- L. Permanent Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated [alumina] [charcoal].
 4. Designed for reverse flow (for heat-pump applications).
 5. End Connections: Socket.
 6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
 7. Maximum Pressure Loss: [2 psig (14 kPa)] <Insert value>.
 8. Rated Flow: <Insert tons (kW).>
 9. Working Pressure Rating: 500 psig (3450 kPa).
 10. Maximum Operating Temperature: 240 deg F (116 deg C).
- M. Liquid Accumulators: Comply with ARI 495.
1. Body: Welded steel with corrosion-resistant coating.
 2. End Connections: Socket or threaded.
 3. Working Pressure Rating: 500 psig (3450 kPa).
 4. Maximum Operating Temperature: 275 deg F (135 deg C).

2.3 REFRIGERANTS

- 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. Atofina Chemicals, Inc.
 2. DuPont Company; Fluorochemicals Div.
 3. Honeywell, Inc.; Genetron Refrigerants.
 4. INEOS Fluor Americas LLC.
 5. <Insert manufacturer's name.>
- C. ASHRAE 34, R-22: Monochlorodifluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Suction Lines [NPS 1-1/2 (DN 40) and Smaller] <Insert pipe size range> for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with [brazed] [or] [soldered] joints.

- B. Suction Lines **[NPS 4 (DN 100) and Smaller]** **[NPS 2 to NPS 4 (DN 50 to DN 100)]** <Insert pipe size range> for Conventional Air-Conditioning Applications: Copper, Type **[ACR]** **[L (B)]**, drawn-temper tubing and wrought-copper fittings with **[brazed]** **[or]** **[soldered]** joints.
- C. Hot-Gas and Liquid Lines[, **and Suction Lines for Heat-Pump Applications**]: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with **[brazed]** **[or]** **[soldered]** joints.
- D. Hot-Gas and Liquid Lines[, **and Suction Lines for Heat-Pump Applications**]: Copper, Type **[ACR]** **[K (A)]** **[L (B)]**, drawn-temper tubing and wrought-copper fittings with soldered joints.
- E. Hot-Gas and Liquid Lines[, **and Suction Lines for Heat-Pump Applications**]:
 - 1. **[NPS 1-1/2 (DN 40) and Smaller]** <Insert pipe size range>: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with **[brazed]** **[or]** **[soldered]** joints.
 - 2. **[NPS 1-1/2 (DN 40) and Smaller]** <Insert pipe size range>: Copper, Type **[ACR]** **[L (B)]**, drawn-temper tubing and wrought-copper fittings with **[brazed]** **[or]** **[soldered]** joints.
 - 3. **[NPS 2 to NPS 3 (DN 50 to DN 80)]** <Insert pipe size range>: Copper, Type **K (A)**, annealed- or drawn-temper tubing and wrought-copper fittings with **[brazed]** **[or]** **[soldered]** joints.
 - 4. **[NPS 4 (DN 100)]** <Insert pipe size>: Copper, Type **[ACR]** **[K (A)]** **[L (B)]**, drawn-temper tubing and wrought-copper fittings with soldered joints.
- F. Safety-Relief-Valve Discharge Piping: Copper, Type **[ACR]** **[K (A)]** **[L (B)]**, drawn-temper tubing and wrought-copper fittings with soldered joints.
- G. Safety-Relief-Valve Discharge Piping:
 - 1. **[NPS 1-1/2 (DN 40) and Smaller]** <Insert pipe size range>: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with **[brazed]** **[or]** **[soldered]** joints.
 - 2. **[NPS 1-1/2 (DN 40) and Smaller]** <Insert pipe size range>: Copper, Type **[ACR]** **[L (B)]**, drawn-temper tubing and wrought-copper fittings with brazed joints.
 - 3. **[NPS 2 to NPS 3 (DN 50 to DN 80)]** <Insert pipe size range>: Copper, Type **K (A)**, annealed- or drawn-temper tubing and wrought-copper fittings with **[brazed]** **[or]** **[soldered]** joints.
 - 4. **[NPS 4 (DN 100)]** <Insert pipe size>: Copper, Type **[ACR]** **[K (A)]** **[L (B)]**, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install **[diaphragm packless]** **[packed-angle]** valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at strainers if they are not an integral part of strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install **[diaphragm packless]** **[packed-angle]** valves on inlet and outlet side of filter dryers.

- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve[, **and in the suction line at the compressor**].
- L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- 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 adjacent to machines to allow service and maintenance.

- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- R. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
 - 9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).
- D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to **500 micrometers (67 Pa)**. If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to **2 psig (14 kPa)**.
 - 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 23 31 13 - METAL DUCTS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Sheet Metal Materials.
2. Duct Liner.
3. Sealant Materials.
4. Hangers and Supports.
5. Duct Fabrication.

B. Related Sections:

1. Section 07 81 33– Mineral-Fiber Fireproofing: For fire-resistant grease duct wrap assemblies.
2. Section 07 84 00 - Firestopping: For fire-resistant sealants for use around duct penetrations and fire-damper installations in fire-rated floors, partitions, and walls.
3. Section 08 31 00 - Access Doors: For wall- and ceiling-mounted access doors for access to concealed ducts.
4. Section 23 05 93 - Testing, Adjusting, and Balancing: For air balancing and final adjusting of manual-volume dampers.
5. Section 23 07 00– HVAC Insulation: For duct insulation.
6. Section 23 33 00– Air Duct Accessories: For dampers, sound-control devices, duct-mounted access doors and panels, turning vanes, and flexible ducts.
7. Section 23 37 00 - Air Outlets and Inlets

1.02 REFERENCES

A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. A36 “Standard Specification for Carbon Structural Steel”
2. A336 “Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts”
3. A480 “Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip”
4. A653 "Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process”
5. C168 “Standard Terminology Relating to Thermal Insulation”
6. C411 “Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation”
7. C916 “Standard Specification for Adhesives for Duct Thermal Insulation”
8. C920 “Standard Specification for Elastomeric Joint Sealants”

9. C1071 "Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)"
- B. American Welding Society (AWS) Publications:
 1. D1.1 "Structural Welding Code - Steel"
 2. D1.2 "Structural Welding Code--Aluminum"
 3. D9.1 "Sheet Metal Welding Code"
- C. National Fire Protection Association (NFPA) Publications:
 1. 90A "Standard for the Installation of Air Conditioning and Ventilating Systems"
 2. 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems"
 3. 96 "Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations"
- D. North American Insulation Manufacturers Association (NAIMA) Publications:
 1. AH124 "Fibrous Glass Duct Liner Standard."
- E. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Publications:
 1. "HVAC Air Duct Leakage Test Manual"
 2. "HVAC Duct Construction Standards—Metal and Flexible"

1.03 DEFINITIONS

- A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C168.

1.04 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by the Engineer of Record. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.05 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
 1. Product Data:
 - a. For duct liner and sealing materials.
 2. Welding Certificates: Copies of certificates indicating welding procedures and personnel comply with requirements in "Quality Assurance" Article.
 3. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
 4. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.06 QUALITY ASSURANCE

- A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project according to AWS D1.1, "Structural Welding Code--Steel" for hangers and supports; AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members; and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.
- C. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.
- D. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Chapter 3, "Duct System," for range hood ducts, unless otherwise indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation.

PART 2 PRODUCTS

2.01 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A653, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A366, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.
- C. Stainless Steel: ASTM A480, Type 316, sheet form with No. 4 finish for surfaces of ducts exposed to view; and Type 304, sheet form with No. 1 finish for concealed ducts.
- D. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.02 DUCT LINER

- A. General: Comply with NFPA 90A or NFPA 90B and NAIMA's "Fibrous Glass Duct Liner Standard."
- B. Materials: ASTM C1071 with coated surface exposed to airstream to prevent erosion of glass fibers.
 - 1. Thickness: 1 inch.
 - 2. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 - 3. Fire-Hazard Classification: Maximum flame-spread rating of 25 and smoke-developed rating of 50, when tested according to ASTM C411.
 - 4. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and ASTM C916.
 - 5. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.

- a. Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
- b. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
- c. Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

2.03 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
 1. Joint and Seam Tape: 2 inches wide; glass-fiber fabric reinforced.
 2. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
 3. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C920, Type S, Grade NS, Class 25, Use O.

2.04 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for building materials.
 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rod or galvanized rods with threads painted after installation.
 2. Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A36/A36M.
 1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.

2.05 FABRICATION - RECTANGULAR DUCT

- A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
 2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

- B. Fabricate range hood exhaust ducts with 0.0598-inch-thick, carbon-steel sheet for concealed ducts and 0.0500-inch-thick stainless steel for exposed ducts. Weld and flange seams and joints. Comply with NFPA 96.
 - 1. For Fire-resistant Grease Duct Wrap Assemblies refer to Section 07 81 33 "Mineral-Fiber Fireproofing"
 - 2. Acceptable Alternative:
 - a. Fire-rated Ductwork:
 - 1) "Flamebar BW11"; Firespray USA (588-576-7600)

2.06 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness are prohibited.
- B. Apply adhesive to liner facing in direction of airflow not receiving metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- E. Do not apply liners in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- G. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profile or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - 1. Fan discharge.
 - 2. Intervals of lined duct preceding unlined duct.
- H. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire-damper sleeve.

2.07 FABRICATION - ROUND DUCT

- A. Round Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

2.08 FABRICATION - ROUND SUPPLY AND EXHAUST FITTING

- A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.

- C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate bend radius of die-formed, gored, and pleated elbows one and one-half times elbow diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
 2. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material-handling classes A and B; and only where space restrictions do not permit using 1.5 bend radius elbows. Fabricate with single-thickness turning vanes.
 3. Round Elbows, 8 Inches and Smaller: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.
 4. Round Elbows, 9 through 14 Inches: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees, unless space restrictions require a mitered elbow. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.
 5. Round Elbows, Larger Than 14 Inches: Fabricate gored elbows, unless space restrictions require a mitered elbow.
 6. Die-Formed Elbows for Sizes through 8 Inches and All Pressures: 0.040 inch thick with two-piece welded construction.

PART 3 EXECUTION

3.01 DUCT INSTALLATION - GENERAL

- A. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.
- B. Construct and install each duct system for the specific duct pressure classification indicated.
- C. Install round ducts in lengths not less than 12 feet, unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with a minimum of projections into duct.
- G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults, electrical equipment spaces and enclosures, and through elevator equipment rooms.

- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Fire and smoke dampers are specified in Section 23 33 00 "Air Duct Accessories." Firestopping materials and installation methods are specified in Section 07 84 00 "Firestopping."

3.02 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Pressure Classification Less Than 2-Inch wg: Transverse and longitudinal joints.
- C. Seal externally insulated ducts before insulation installation.
- D. Materials: 3M Brand No. 800.

3.03 HANGING AND SUPPORTING

- A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 feet and at each floor.
- D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- E. Install concrete inserts before placing concrete.
- F. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3.04 CONNECTIONS

- A. Connect equipment with flexible connectors according to Section 23 33 00 "Duct Accessories."
- B. For branch, outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- C. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."

3.05 ADJUSTING

- A. Refer to Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for detailed procedures.

3.06 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect the system. Vacuum interior as well as exterior of ducts before final acceptance to remove dust and debris.

END OF SECTION

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Manual-Volume Dampers
2. Fire Dampers
3. Turning Vanes
4. Duct-Mounted Access Doors
5. Flexible Connectors
6. Flexible Ducts
7. Accessories

B. Related Sections:

1. Section 08 31 00 - Access Doors and Panels: For wall- and ceiling-mounted access doors and panels.
2. Section 23 05 53 - Identification for HVAC Piping and Equipment.
3. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
4. Section 23 37 00 - Air Outlets and Inlets.
5. Section 25 51 00 – Integrated Automation Control of Guestroom Equipment
6. Section 28 31 00 - Fire Alarm and Detection Systems: For duct-mounted fire and smoke detectors.

1.02 REFERENCES

A. North American Insulation Manufacturers Association (NAIMA) Publications:

1. AH124 "Fibrous Glass Duct Liner Standard."

B. National Fire Protection Association (NFPA) Publications:

1. 90A "Standard for the Installation of Air Conditioning and Ventilating Systems"
2. 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems"

C. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Publications:

1. "Fire Damper and Heat Stop Guide for Air Handling Systems"
2. "HVAC Duct Construction Standards—Metal and Flexible"

D. Underwriter's Laboratories, Inc. (UL) Standards:

1. 181 "Standard for Factory-Made Air Ducts and Air Connectors"
2. 181B "Closure Systems for Use With Flexible Air Ducts and Air Connectors"
3. 555 "Fire Dampers"
4. 555C "Standard for Safety for Ceiling Dampers"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Submit "Letter of Conformance" in accordance with Section 01 33 00 indicating specified items selected for use in project with the following supporting data.
 - 1. Product Data: For the following:
 - a. Manual-volume dampers.
 - b. Fire dampers & Combination Fire Smoke Dampers.
 - c. Duct-mounted access doors.
 - d. Flexible ducts.
 - 2. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
 - a. Special fittings and manual- and automatic-volume-damper installations.
 - b. Fire damper installations, including sleeves and duct-mounted access doors and panels.
 - 3. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.04 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Sheet Metal and Air Conditioning Contractors National Association, Inc. manuals (SMACNA) except where details or notes on drawings indicate otherwise.
 - 1. HVAC Duct Construction Standards—Metal and Flexible.
 - 2. Fire Damper and Heat Stop Guide for Air Handling Systems.
- C. Underwriters Laboratories (UL) Standard for Safety UL 181, UL 555.

1.05 EXTRA MATERIALS

- A. Furnish extra materials described in Section 01 78 43 "Spare Parts and Materials" that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- 1. Manual Volume Dampers.
 - a. Ruskin Company (816-761-7476)
 - b. Air Balance, Division of Mestek (419-865-5000)
 - c. Prefco (Perfect Air Control, Inc.) (800-437-6653)

2. Fire Dampers.
 - a. Ruskin Company (816-761-7476)
 - b. Air Balance, Division of Mestek (419-865-5000)
 - c. Prefco (Perfect Air Control, Inc.) (800-437-6653)
3. Ceiling Fire Dampers
 - a. Ruskin Company (816-761-7476)
 - b. Air Balance, Division of Mestek (419-865-5000)
 - c. Prefco (Perfect Air Control, Inc.) (800-437-6653)
4. Flexible Connectors.
 - a. Ventfabrics, Inc. (800-621-1207)
 - b. Ward Industries, Inc. (630-595-7320)
 - c. Vent Products Co. (800-368-8368)
5. Flexible Ducts
 - a. Clevaflex, Ltd. (216-941-6505)
 - b. Approved Substitution

2.02 MANUAL-VOLUME DAMPERS

- A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized, sheet steel.
 3. Blade Axles: Nonferrous.
 4. Tie Bars and Brackets: Galvanized steel.
- C. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.03 FIRE DAMPERS

- A. General: Labeled to UL 555.
- B. Fire Rating: One and one-half hour unless noted otherwise.
- C. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- D. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.

1. Minimum Thickness: 0.052 inch or 0.138 inch thick and length to suit application.
 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- E. Mounting Orientation: Vertical or horizontal as indicated.
- F. Blades: Roll-formed, interlocking, 0.034 inch thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034 inch thick, galvanized steel blade connectors.
- G. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.
- H. Fusible Link: Replaceable, 165 F rated as indicated.
- I. Provide access door in duct adjacent to each fire damper.

2.04 CEILING FIRE DAMPERS

- A. General: Labeled to UL 555C; comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
- B. Frame: 0.040 inch thick, galvanized, sheet steel; round or rectangular; style to suit ceiling construction.
- C. Blades: 0.034 inch thick, galvanized, sheet steel with nonasbestos refractory insulation.
- D. Fusible Link: Replaceable, 165 deg F rated.

2.05 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards—Metal and Flexible."
- B. Manufactured Turning Vanes: Fabricate of 1-1/2 inch wide, curved blades set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into side strips suitable for mounting in ducts.

2.06 DUCT-MOUNTED ACCESS DOORS

- A. General: Fabricate doors airtight and suitable for duct pressure class.
- B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch thick, fibrous-glass.

2.07 FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4 inch wide, 0.028 inch thick, galvanized, sheet steel. Select metal compatible with connected ducts.
- C. Transverse Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 4-3/8 inch wide, 0.028 inch thick, galvanized, sheet steel. Select metal compatible with connected ducts.

- D. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.
 - 3. Minimum Movement: 2 inches.
- E. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp, and 440 lbf/inch in the filling.
 - 3. Minimum Movement: 2 inches.
- F. High-Corrosive-Environment System Flexible Connectors: Glass fabric coated with a chemical-resistant coating (For use in pool area equipment room).
 - 1. Minimum Weight: 14 oz./sq. yd.
 - 2. Tensile Strength: 450 lbf/inch in the warp, and 340 lbf/inch in the filling.
 - 3. Minimum Movement: 2 inches.

2.08 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1.
- B. Flexible Ducts, Uninsulated: Corrugated aluminum. For use on dryer vents only.
- C. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch thick, glass-fiber insulation around a continuous inner liner.
 - 1. Reinforcement: Steel-wire helix encapsulated in inner liner.
 - 2. Outer Jacket: Glass-reinforced, silver Mylar with a continuous hanging tab, integral fibrous-glass tape, and nylon hanging cord.
 - 3. Inner Liner: Polyethylene film.
- D. Pressure Rating: 6-inch wg positive, 1/2-inch wg negative.

2.09 ACCESSORIES

- A. Louvers:
 - 1. Provide blank off panels for unused portions of louvers. Panels shall be double wall construction with 0.032 inch aluminum, and 2 inch thick, internal glass fiber insulation in accordance with SMACNA "HVAC Duct Construction Standards—Metal and Flexible."
- B. Open ducts in suspended ceiling: No. 16 USSG, 3/4 inch square mesh, screen over each opening; with 1 inch wide galvanized steel enclosing frame and flanged duct opening to receive frame. In lieu of screen and volume damper, provide register or grille plus opposed blade volume damper.
- C. Duct sleeves: Minimum 20 gauge USSG galvanized sheet steel unless otherwise indicated.
 - 1. Clearances:
 - a. Non-insulated duct: 1 inch between duct and sleeve on all sides.

- b. Insulated duct: 1 inch between insulation and sleeve on all sides.
- c. Grilles, registers and diffusers: Zero clearance.
- 2. Provide closure collars for exposed ducts on each side of wall or floor opening. Collars shall be galvanized sheet metal, minimum 4 inch wide, and fit tight against surface and around duct or insulation. Install with nails 6 inch on center.
- 3. Framed openings: Provide clearances and closure collars the same as for duct sleeves.
- 4. Duct-mounted automatic control devices: Mount on mechanical equipment all devices related to automatic controls such as automatic dampers.
- D. Cleanout Doors (Kitchen and Laundry Dryer Exhaust): Horizontal ducts shall be mounted maximum 20 ft. apart and in change of direction. Cleanout doors on horizontal duct shall be mounted on side of duct. Bottom edge shall be not less than 2 inches above bottom of duct. Cleanout doors at vertical ducts shall be mounted at base. Door and frame shall be same gauge as duct. Hinges shall be Ventlock No. 260, extra heavy zinc plated. Latches shall be Ventlock No. 140, cast zinc. Gaskets shall be between door and frame. Gaskets shall be 1/8 inch double thickness rated 2,000 deg F for kitchen exhaust system. Cleanout door size shall be maximum 24 inch x 24 inch and minimum shall be 24 inch one side, and other side shall be 2 inch less than duct height.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards—Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire dampers according to manufacturer's UL-approved written instructions.
 - 1. Install fusible links in fire dampers.
- E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, automatic dampers, smoke detectors, outside and exhaust air plenums equipment, and other locations as indicated.
 - 1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
 - 2. Install access panels on side of duct where adequate clearance is available.
- F. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment."
- G. Provide flexible connections at fan and building joints.
- H. Install automatic dampers supplied by the automatic temperature control system manufacturer. Notch end of rod and label duct/casing to indicate open and closed blade position.
- I. Install zone control exhaust terminals and make required control and electrical connections.
- J. Provide volume dampers at following locations:
 - 1. In all duct splits and branch connections of supply, return, and exhaust systems.
 - 2. Ducts connecting to common plenums.

3. Ducts serving single outlet.
 4. At open return duct in hung ceiling.
 5. Other locations as indicated on drawings.
- K. Provide access doors in following locations and as indicated on the Drawings.
1. Automatic dampers: linkage side.
 2. Main balancing dampers.
 3. Fire dampers.
 4. Smoke detection heads.
 5. On both sides of ducts where necessary to provide maintenance accessibility to equipment on the other side.
 6. Outside air and exhaust air plenums.
- L. Flexible Duct Installation:
1. Installation shall be in accordance with SMACNA and local building code standards.
 2. Flexible duct runs shall be a maximum of 5 feet, straight lengths, no bends.
 3. Connections to beaded sheet metal fittings shall be with 3 wraps of approved tape and stainless steel draw band for tight seal. Seal the outer jacket with 3 wraps of approved UL 181B tape.
 4. A 1 ½" minimum strap shall be used to support the flexible duct at a distance not greater than 5'-0". Maximum permissible sag is ½" per foot of duct length.
- 3.02 ADJUSTING
- A. Adjust duct accessories for proper settings.
 - B. Adjust fire dampers for proper action.
 - C. Final positioning of manual-volume dampers is specified in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC".

END OF SECTION

SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Centrifugal Roof Ventilators.
2. Up-blast Roof Exhaust Fans (Kitchen Hood Exhaust).
3. Ceiling-Mounted Ventilators.
4. In-Line Centrifugal Fans.
5. Motors
6. Factory Finishes
7. Quality Control

B. Related Sections:

1. Section 23 05 00 – Common Work Results for HVAC
2. Section 23 05 48 - Mechanical Sound, Vibration and Seismic Control.
3. Section 23 05 53 – Identification for HVAC Piping and Equipment
4. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
5. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
6. Section 23 09 00 – Instrumentation and Control for HVAC
7. Section 26 29 13 - Enclosed Controllers: For motor starters.
8. Section 26 51 00 – Interior Lighting: Light Fixture Matrix For Guestroom Toilet Ceiling Mounted Ventilators.

C. Products Supplied But Not Installed Under This Section:

1. Roof curbs for roof-mounted exhaust fans.

1.02 REFERENCES

A. Air Movement & Control Association International, Inc. (AMCA) Publications:

1. 99 "Standards Handbook" (Revised 2003)
2. 210 "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating"
3. 300 "Reverberant Room Method for Sound Testing of Fans"
4. 301 "Methods for Calculating Fan Sound Ratings from Laboratory Test Data"

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

1. B117 "Standard Practice for Operating Salt Spray (Fog) Apparatus"

C. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. MG 1 "Motors and Generators"

D. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

E. Underwriter's Laboratories, Inc. (UL) Publications:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors"
2. 486B "Standard for Wire Connectors for Use With Aluminum Conductors"
3. 705 "Standard for Power Ventilators"

1.03 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on actual site elevations.
- B. Operating Limits: Classify according to AMCA 99.
- C. Fan Schedule: The following information is described in an equipment schedule on the Drawings.
 1. Fan performance data including capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
 2. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.
 1. Product Data including rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:
 - a. Certified fan performance curves with system operating conditions indicated.
 - b. Certified fan sound power ratings.
 - c. Motor ratings and electrical characteristics plus motor and electrical accessories.
 - d. Material gages and finishes, including color charts.
 - e. Dampers, including housings, linkages, and operators.
 2. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.
 4. Maintenance data for power ventilators to include in the operation and maintenance manual specified in Division 01 and in Section 23 05 00 "Common Work Results for HVAC."

1.05 QUALITY ASSURANCE

- A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.

- B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- C. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.
- D. NEMA Compliance: Provide components required as part of fans that comply with applicable NEMA standards.
- E. UL Standard: Provide power ventilators that comply with UL 705.

1.06 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements. Verify clearances.
- B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and fans have been commissioned.

1.07 COORDINATION AND SCHEDULING

- A. Coordinate the size and location of structural steel support members.
- B. Coordinate the installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 07 Sections.

1.08 EXTRA MATERIALS

- A. Furnish extra materials described in Section 01 78 43 (01790) "Spare Parts and Materials" that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Exhaust Fans:
 - a. Carnes Co.
 - b. Loren Cook Company
 - c. Greenheck Fan Corporation
 - d. PennBarry

2.02 CENTRIFUGAL ROOF VENTILATORS

- A. Description: Belt-driven or direct-drive centrifugal fans, as indicated, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.

2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust air stream.
- E. Accessories: The following items are required as indicated:
 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent. (Direct drive fans only).
 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 3. Bird Screens: Removable 1/2-inch mesh, aluminum or brass wire.
 4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
 5. Roof Curbs: Galvanized steel; mitered and welded corners; 2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 2-inch wood nailer. Size as required to suit roof opening and fan base. Built-in cant and mounting flange.
 - a. Overall Height: 12 inches. Minimum.

2.03 UPBLAST ROOF EXHAUST

- A. Description: Belt-driven or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- B. Housing: Removable, spun-aluminum, square one-piece, aluminum base with venturi inlet cone.
 1. Up-blast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 4. Fan and motor isolated from exhaust airstream.
- E. Accessories:
 1. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 2. Bird Screens: Removable, 1/2 inch(13-mm) mesh, aluminum or brass wire.
 3. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
- F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2 inch thick, rigid, fiberglass insulation adhered to inside walls with galvanized steel metal liner; and 1-1/2 inch wood nailer. Size as required to suit roof opening and fan base.

2.04 CEILING-MOUNTED VENTILATORS

- A. Description: Centrifugal fans designed for installing in ceiling or wall, or for concealed in-line applications.
- B. Housing: Galvanized steel lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Aluminum, louvered grille or egg-crate with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Variable-Speed Controller Mounted on Fan Housing: Solid-state control to reduce speed from 100 percent to less than 50 percent.
- G. Sound Level: Guestroom Toilets shall have a maximum of 0.3 Sones per HVI 915 Procedure for Loudness Rating of Residential Fan Products – Refer to Light Fixture Matrix for approved manufacturers and models.
- H. Accessories: Manufacturer's standard roof jack or wall cap, and transition fittings.

2.05 IN-LINE CENTRIFUGAL FANS

- A. Description: In-line, belt-driven, or direct-drive centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, and accessories.
- B. Housing: Split, spun-aluminum housing, with aluminum straightening vanes; inlet and outlet flanges; and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Drive Units: Motor encased in housing out of air stream, factory wired to disconnect located on outside of fan housing.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- F. Accessories: The following accessories are required as indicated:
 - 1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
 - 2. Companion Flanges: For inlet and outlet duct connections.
 - 3. Fan Guards: Expanded metal in removable frame. Provide fan guards for units not connected to ductwork.

2.06 MOTORS

- A. Refer to Section 23 05 13 - "Common Motor Requirements for HVAC Equipment" for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
- C. Enclosure Type: The following features are required as indicated:
 - 1. Open dripproof motors where satisfactorily housed or remotely located during operation.

2.07 FACTORY FINISHES

- A. Sheet Metal Parts: Prime coat before final assembly.
- B. Exterior Surfaces: Baked-enamel finish coat after assembly.
- C. Aluminum Parts: No finish required.

2.08 SOURCE QUALITY CONTROL

- A. Testing Requirements: The following factory tests are required as indicated:
 - 1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA Seal.
 - 2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the power ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install power ventilators according to manufacturer's written instructions.
- B. Support units using the vibration-control devices indicated. Vibration-control devices are specified in Section 23 05 48 - "Vibration, and Seismic Control for HVAC Piping and Equipment."
 - 1. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.
 - a. Installation of roof curbs is specified in Division 07 Sections.
 - 2. Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.
 - 3. Ceiling Units: Suspend units from structure using steel wire or metal straps.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.03 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.
- B. Electrical: Conform to applicable requirements in Division 26 Sections.
- C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of fans, including duct and electrical connections, and to report results in writing.

3.05 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

3.06 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.07 COMMISSIONING

- A. Final Checks before Startup: Perform the following operations and checks before startup:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ducts, and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.
 - 3. Perform cleaning and adjusting specified in this Section.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 - 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
 - 7. Disable automatic temperature-control operators.
- B. Starting procedures for fans are as follows:
 - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - 2. Measure and record motor voltage and amperage.
- C. Shut unit down and reconnect automatic temperature-control operators.
- D. Refer to Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for procedures for air-handling-system testing, adjusting, and balancing.
- E. Replace fan and motor pulleys as required to achieve design conditions.

3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

1. Conduct training as specified in Section 01 79 00 "Training".
2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive.

END OF SECTION

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fan-powered air terminal units.
2. Shutoff, single-duct air terminal units.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports[**and seismic restraints**] shall withstand the effects of gravity[**and seismic**] loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" [and] [ASCE/SEI 7] [SMACNA's "**Seismic Restraint Manual: Guidelines for Mechanical Systems**"] <Insert document>.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

- C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.

D. Delegated-Design Submittal:

1. Materials, fabrication, assembly, and spacing of hangers and supports.
2. Design Calculations: Calculations[, **including analysis data signed and sealed by the qualified professional engineer responsible for their preparation**] for selecting hangers and supports[**and seismic restraints**].

- E. Field quality-control reports.

- F. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 PARALLEL FAN-POWERED AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
1. Anemostat Products; a Mestek Company.
 2. Carnes.
 3. Environmental Technologies, Inc.
 4. Krueger.
 5. METALAIRE, Inc.
 6. Nailor Industries Inc.
 7. Price Industries.
 8. Titus.
 9. Trane; a business of American Standard Companies.
 10. Tuttle & Bailey.
 11. **<Insert manufacturer's name>**.
- C. Configuration: Volume-damper assembly and fan in parallel arrangement inside unit casing with control components inside a protective metal shroud.
- D. Casing: **[0.034-inch (0.85-mm) steel] [0.032-inch (0.8-mm) aluminum]**, **[single] [double]** wall.
1. Casing Lining: Adhesive attached, **[1/2-inch- (13-mm-)] [3/4-inch- (19-mm-)] [1-inch- (25-mm-)]** thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. Cover liner with nonporous foil.
 - b. Cover liner with nonporous foil and perforated metal.
 2. Casing Lining: Adhesive attached, **[1/2-inch- (13-mm-)] [3/4-inch- (19-mm-)] [1-inch- (25-mm-)]** thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 3. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
 4. Air Outlet: S-slip and drive connections.

5. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
 6. Fan: Forward-curved centrifugal, located at plenum air inlet.
 7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, [2] [3] percent of nominal airflow at [3-inch wg (750-Pa)] [6-inch wg (1500-Pa)] inlet static pressure.
 2. Damper Position: Normally [open] [closed].
- F. Velocity Sensors: Multipoint array with velocity sensors in cold- and hot-deck air inlets and air outlets.
- G. Motor:
1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 2. Type: [Permanent-split capacitor with SCR for speed adjustment] [Electronically commutated motor].
 3. Fan-Motor Assembly Isolation: Rubber isolators.
 4. Enclosure: [Open dripproof] [Totally enclosed, fan cooled] [Totally enclosed, air over] [Open, externally ventilated] [Totally enclosed, nonventilated] [Severe duty] [Explosion proof] [Dust-ignition-proof machine].
 5. Enclosure Materials: [Cast iron] [Cast aluminum] [Rolled steel].
 6. Motor Bearings: <Insert special requirements>.
 7. Unusual Service Conditions:
 - a. Ambient Temperature: <Insert deg F (deg C)>.
 - b. Altitude: <Insert feet (m)> above sea level.
 - c. High humidity.
 - d. <Insert conditions>.
 8. Efficiency: Premium efficient.
 9. NEMA Design: <Insert designation>.
 10. Service Factor: <Insert value>.
 11. Motor Speed: [Single speed] [Multispeed].
 - a. Speed Control: Infinitely adjustable with electronic controls.
 12. Electrical Characteristics:
 - a. Horsepower: <Insert value>.
 - b. Volts: [120] [208] [230] [460] <Insert value>.
 - c. Phase: [Single] [Poly].
 - d. Hz: 60.
 - e. Full-Load Amperes: <Insert value>.
 - f. Minimum Circuit Ampacity: <Insert value>.

- g. Maximum Overcurrent Protection: **<Insert amperage>**.
- H. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Material: Polyurethane foam having 70 percent arrestance and 3 MERV.
 - 2. Material: Glass fiber treated with adhesive; having 80 percent arrestance and 5 MERV.
 - 3. Material: Pleated cotton-polyester media having 90 percent arrestance and 7 MERV.
 - 4. Thickness: **[2 inches (50 mm)] [1 inch (25 mm)]**.
- I. Attenuator Section: **[0.034-inch (0.85-mm) steel] [0.032-inch (0.8-mm) aluminum]** sheet.
 - 1. Lining: Adhesive attached, **[1/2-inch- (13-mm-)] [3/4-inch- (19-mm-)] [1-inch- (25-mm-)]** thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. Cover liner with nonporous foil.
 - b. Cover liner with nonporous foil and perforated metal.
 - 2. Lining: Adhesive attached, **3/4-inch- (19-mm-)** thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- J. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch (2.5 mm)**, and rated for a minimum working pressure of **200 psig (1380 kPa)** and a maximum entering-water temperature of **220 deg F (104 deg C)**. Include manual air vent and drain valve.
 - 1. Location: Plenum air inlet.
- K. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
 - 1. Location: Plenum air inlet.
 - 2. Stage(s): **[1] [2] [3]**.
 - 3. Access door interlocked disconnect switch.
 - 4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 - 5. Nickel chrome 80/20 heating elements.
 - 6. Airflow switch for proof of airflow.
 - 7. Fan interlock contacts.
 - 8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 - 9. Mercury contactors.
 - 10. Magnetic contactor for each step of control (for three-phase coils).

- L. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
 - 1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
 - 2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
 - 3. Disconnect Switch: Factory-mounted, fuse type.
- M. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- N. Electric Controls: 24-V damper actuator with wall-mounted electric thermostat and appropriate mounting hardware.
- O. Electronic Controls: Bidirectional damper operator and microprocessor-based controller with integral airflow transducer and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:
 - 1. Occupied and unoccupied operating mode.
 - 2. Remote reset of airflow or temperature set points.
 - 3. Adjusting and monitoring with portable terminal.
 - 4. Communication with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC."

2.2 SERIES FAN-POWERED AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - 1. Anemostat Products; a Mestek Company.
 - 2. Carnes.
 - 3. Environmental Technologies, Inc.
 - 4. Krueger.
 - 5. METALAIRE, Inc.
 - 6. Nailor Industries Inc.
 - 7. Price Industries.
 - 8. Titus.
 - 9. Trane; a business of American Standard Companies.
 - 10. Tuttle & Bailey.
 - 11. **<Insert manufacturer's name>**.

- C. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud [**for installation above a ceiling**] [**and**] [**within a raised access floor**].
- D. Casing: [**0.034-inch (0.85-mm)** steel] [**0.032-inch (0.8-mm)** aluminum], [single] [double] wall.
 - 1. Casing Lining: Adhesive attached, [**1/2-inch- (13-mm-)**] [**3/4-inch- (19-mm-)**] [**1-inch- (25-mm-)**] thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. Cover liner with nonporous foil.
 - b. Cover liner with nonporous foil and perforated metal.
 - 2. Casing Lining: Adhesive attached, [**1/2-inch- (13-mm-)**] [**3/4-inch- (19-mm-)**] [**1-inch- (25-mm-)**] thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - 3. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
 - 4. Air Outlet: S-slip and drive connections.
 - 5. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
 - 6. Fan: Forward-curved centrifugal.
 - 7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage: ARI 880 rated, [**2**] [**3**] percent of nominal airflow at [**3-inch wg (750-Pa)**] [**6-inch wg (1500-Pa)**] inlet static pressure.
 - 2. Damper Position: Normally [**open**] [**closed**].
- F. Velocity Sensors: Multipoint array with velocity sensors in cold- and hot-deck air inlets and air outlets.
- G. Motor:
 - 1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 2. Type: [**Permanent-split capacitor with SCR for speed adjustment**] [**Electronically commutated motor**].
 - 3. Fan-Motor Assembly Isolation: Rubber isolators.
 - 4. Enclosure: [**Open dripproof**] [**Totally enclosed, fan cooled**] [**Totally enclosed, air over**] [**Open, externally ventilated**] [**Totally enclosed, nonventilated**] [**Severe duty**] [**Explosion proof**] [**Dust-ignition-proof machine**].
 - 5. Enclosure Materials: [**Cast iron**] [**Cast aluminum**] [**Rolled steel**].
 - 6. Motor Bearings: <**Insert special requirements**>.

7. Unusual Service Conditions:
 - a. Ambient Temperature: **<Insert deg F (deg C)>**.
 - b. Altitude: **<Insert feet (m)>** above sea level.
 - c. High humidity.
 - d. **<Insert conditions>**.
8. Efficiency: Premium efficient.
9. NEMA Design: **<Insert designation>**.
10. Service Factor: **<Insert value>**.
11. Motor Speed: **[Single speed] [Multispeed]**.
 - a. Speed Control: Infinitely adjustable with electronic controls.
12. Electrical Characteristics:
 - a. Horsepower: **<Insert value>**.
 - b. Volts: **[120] [208] [230] [460] <Insert value>**.
 - c. Phase: **[Single] [Poly]**.
 - d. Hz: 60.
 - e. Full-Load Amperes: **<Insert value>**.
 - f. Minimum Circuit Ampacity: **<Insert value>**.
 - g. Maximum Overcurrent Protection: **<Insert amperage>**.
- H. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 1. Material: Polyurethane foam having 70 percent arrestance and 3 MERV.
 2. Material: Glass fiber treated with adhesive; having 80 percent arrestance and 5 MERV.
 3. Material: Pleated cotton-polyester media having 90 percent arrestance and 7 MERV.
 4. Thickness: **[2 inches (50 mm)] [1 inch (25 mm)]**.
- I. Attenuator Section: **[0.034-inch (0.85-mm) steel] [0.032-inch (0.8-mm) aluminum]** sheet.
 1. Lining: Adhesive attached, **[1/2-inch- (13-mm-)] [3/4-inch- (19-mm-)] [1-inch- (25-mm-)]** thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. Cover liner with nonporous foil.
 - b. Cover liner with nonporous foil and perforated metal.
 2. Lining: Adhesive attached, **3/4-inch- (19-mm-)** thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- J. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch (2.5 mm)**, and rated for a minimum working pressure of **200 psig (1380 kPa)** and a

maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.

- K. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
1. Stage(s): [1] [2] [3].
 2. Access door interlocked disconnect switch.
 3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 4. Nickel chrome 80/20 heating elements.
 5. Airflow switch for proof of airflow.
 6. Fan interlock contacts.
 7. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 8. Mercury contactors.
 9. Magnetic contactor for each step of control (for three-phase coils).
- L. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
 2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
 3. Disconnect Switch: Factory-mounted, fuse type.
- M. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- N. Electric Controls: 24-V damper actuator with wall-mounted electric thermostat and appropriate mounting hardware.
- O. Electronic Controls: Bidirectional damper operator and microprocessor-based controller with integral airflow transducer and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:
1. Occupied and unoccupied operating mode.
 2. Remote reset of airflow or temperature set points.
 3. Adjusting and monitoring with portable terminal.
 4. Communication with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC."

2.3 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
1. Anemostat Products; a Mestek Company.
 2. Carnes.
 3. Environmental Technologies, Inc.
 4. Krueger.
 5. METALAIRE, Inc.
 6. Nailor Industries Inc.
 7. Phoenix Controls Corporation.
 8. Price Industries.
 9. Titus.
 10. Trane; a business of American Standard Companies.
 11. Trox USA Inc.; a subsidiary of the TROX GROUP.
 12. Tuttle & Bailey.
 13. Warren Technology.
 14. **<Insert manufacturer's name>**.
- C. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- D. Casing: **[0.034-inch (0.85-mm) steel] [0.032-inch (0.8-mm) aluminum]**, **[single] [double]** wall.
1. Casing Lining: Adhesive attached, **[1/2-inch- (13-mm-)] [3/4-inch- (19-mm-)] [1-inch- (25-mm-)]** thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. Cover liner with nonporous foil.
 - b. Cover liner with nonporous foil and perforated metal.
 2. Casing Lining: Adhesive attached, **[1/2-inch- (13-mm-)] [3/4-inch- (19-mm-)] [1-inch- (25-mm-)]** thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 3. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 4. Air Outlet: S-slip and drive connections[, **size matching inlet size**].
 5. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

- E. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from **0 to 140 deg F (minus 18 to plus 60 deg C)**, shall be impervious to moisture and fungus, shall be suitable for **10-inch wg (2500-Pa)** static pressure, and shall be factory tested for leaks.
- F. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage: ARI 880 rated, **[2] [3]** percent of nominal airflow at **[3-inch wg (750-Pa)] [6-inch wg (1500-Pa)]** inlet static pressure.
 - 2. Damper Position: Normally **[open] [closed]**.
- G. Attenuator Section: **[0.034-inch (0.85-mm) steel] [0.032-inch (0.8-mm) aluminum]** sheet.
 - 1. Lining: Adhesive attached, **[1/2-inch- (13-mm-)] [3/4-inch- (19-mm-)] [1-inch- (25-mm-)]** thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. Cover liner with nonporous foil.
 - b. Cover liner with nonporous foil and perforated metal.
 - 2. Lining: Adhesive attached, **3/4-inch- (19-mm-)** thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- H. Multioutlet Attenuator Section: With **[two] [three] [four]** **<Insert number> [6-inch- (150-mm-)] [8-inch- (200-mm-)] [10-inch- (250-mm-)]** diameter collars, each with locking butterfly balancing damper.
- I. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch (2.5 mm)**, and rated for a minimum working pressure of **200 psig (1380 kPa)** and a maximum entering-water temperature of **220 deg F (104 deg C)**. Include manual air vent and drain valve.
- J. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
 - 1. Access door interlocked disconnect switch.
 - 2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 - 3. Nickel chrome 80/20 heating elements.
 - 4. Airflow switch for proof of airflow.
 - 5. Fan interlock contacts.
 - 6. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 - 7. Mercury contactors.
 - 8. Magnetic contactor for each step of control (for three-phase coils).

- K. Electric Controls: Damper actuator and thermostat.
 - 1. Damper Actuator: 24 V, powered closed, [**spring return open**] [**powered open**].
 - 2. Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit and Celsius, and space temperature set point.
- L. Electronic Controls: Bidirectional damper operator and microprocessor-based thermostat with integral airflow transducer and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:
 - 1. Damper Actuator: 24 V, powered closed, [**spring return open**] [**powered open**].
 - 2. Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to **4-inch wg (1000 Pa)**; and shall have a multipoint velocity sensor at air inlet.
 - 3. Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.
- M. Direct Digital Controls: Single-package unitary controller and actuator specified in Division 23 Section "Instrumentation and Control for HVAC."
- N. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:
 - 1. Damper Actuator: 24 V, powered closed, [**spring return open**] [**powered open**].
 - 2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
 - a. Occupied and unoccupied operating mode.
 - b. Remote reset of airflow or temperature set points.
 - c. Adjusting and monitoring with portable terminal.
 - d. Communication with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC."
 - 3. Room Sensor: Wall mounted, with temperature set-point adjustment and access for connection of portable operator terminal.

2.4 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Steel Cables: [**Galvanized steel complying with ASTM A 603**] [**Stainless steel complying with ASTM A 492**].

- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.5 SEISMIC-RESTRAINT DEVICES

- A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by **[an evaluation service member of the ICC Evaluation Service] [the Office of Statewide Health Planning and Development for the State of California] [an agency acceptable to authorities having jurisdiction]**.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least **[four] <Insert number>** times the maximum seismic forces to which they will be subjected.
- B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- C. Restraint Cables: **[ASTM A 603, galvanized] [ASTM A 492, stainless]**-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; with an automatic-locking and clamping device or double-cable clips.
- D. Hanger Rod Stiffener: **[Steel tube or steel slotted-support-system sleeve with internally bolted connections] [Reinforcing steel angle clamped]** to hanger rod.
- E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.6 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
 - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, **[coil type,]** and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

3.2 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 and for slabs more than **4 inches (100 mm)** thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than **4 inches (100 mm)** thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. 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.

3.3 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with **[SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."]** **[ASCE/SEI 7.]**
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on air terminal units that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by **[an evaluation service member of the ICC Evaluation Service]** **[the Office of Statewide Health Planning and Development for the State of California]** **[an agency acceptable to authorities having jurisdiction].**

- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Install heavy-duty sleeve anchors with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.4 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to [**Division 23 Section "Metal Ducts."**] [**Division 23 Section "Nonmetal Ducts."**]
- D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.5 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.6 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. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 2. Leak Test: After installation, fill water coils 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 proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 STARTUP SERVICE

- A. **[Engage a factory-authorized service representative to perform] [Perform]** startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 3. Verify that controls and control enclosure are accessible.
 4. Verify that control connections are complete.
 5. Verify that nameplate and identification tag are visible.
 6. Verify that controls respond to inputs as specified.
 7. **<Insert startup steps if any>**.

3.8 DEMONSTRATION

- A. **[Engage a factory-authorized service representative to train] [Train]** Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Diffusers
2. Registers
3. Grilles
4. Louvers

B. Related Sections:

1. Section 23 33 00– Air Duct Accessories.
2. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.02 REFERENCES

A. American Architectural Manufacturers Association (AAMA) Publications:

1. 2604 “Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusion and Panels”
2. 2605 “Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels”

B. Air Movement & Control Association International, Inc. (AMCA)

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Publications:

1. 70 "Method of Testing for Rating the Performance of Air Outlets and Inlets"

D. National Fire Protection Association (NFPA) Publications:

1. 90A “Standard for the Installation of Air Conditioning and Ventilating Systems”

1.03 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Submit “Letter of Conformance” in accordance with Section 01 33 00 indicating specified items selected for use in project with the following supporting data.
1. Product Data: For each model indicated, include the following:
 - a. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.

- b. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
- c. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
- d. Assembly Drawing: For each type of air outlet and inlet: indicate materials and methods of assembly of components.

1.05 QUALITY ASSURANCE

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated.
- B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of air-conditioning and Ventilating Systems."

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Diffusers, Registers, and Grilles:
 - a. Titus
 - b. Carnes
 - c. Krueger
 - 2. Exterior Louvers:
 - a. Ruskin Company
 - b. American Warming & Ventilating Co.
 - c. Arrow United Industries

2.02 MANUFACTURED UNITS

- A. Diffusers, Registers, and Grilles:
 - 1. As scheduled on Drawings
- B. Exterior Louvers:
 - 1. Provide exterior wall louvers; size as indicated on Drawings.
 - 2. Louvers shall be AMCA certified for zero water penetration and maximum 1/8-inch pressure drop at a free area velocity of 900 fpm.
 - 3. Louvers shall be stationary drainage blade type with a 4" deep constructed of 0.081" thick 6063-TS extruded aluminum complete with 1/2" aluminum screen in removable frame.
 - 4. Frames shall be box type for masonry construction and flange type for frame construction.
 - 5. Louver Finish:
 - a. Two-coat 50% PVDF factory applied finish in accordance with AAMA 2604, dry film thickness 1.2 mil.

- b. Color: Refer to Exterior Finish Index.
- 6. Louvers shall be minimum 4" deep, storm proof, extruded aluminum, drainable, with 1/2" square mesh aluminum screen on interior face.

2.03 SOURCE QUALITY CONTROL

- A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other item conflict with installation notify Owner's Representative for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.04 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION

SECTION 23 41 00 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal panel filters.
2. Flat panel filters.
3. Pleated panel filters.
4. Nonsupported bag filters.
5. Rigid cell box filters.
6. V-bank cell filters.
7. Self-supported pocket filters.
8. Front- and rear-access filter frames.
9. Side-service housings.
10. Filter gages.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5, "Systems and Equipment."
2. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

C. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.

1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.

D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. ASHRAE Compliance:

1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."

2. Comply with ASHRAE 52.1 for arrestance and ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.
- B. Comply with NFPA 90A and NFPA 90B.

PART 2 - PRODUCTS

2.1 METAL PANEL FILTERS

- A. Description: Factory-fabricated, self-supported, cleanable, all-metal, impingement-type, panel-type, permanent air filters with holding frames.
1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
 - d. Filtration Group.
 - e. Flanders-Precisionaire.
 - f. Koch Filter Corporation.
 - g. Purafil, Inc.
 - h. Research Products Corp.
 - i. **<Insert manufacturer's name>**.
- B. Media: **[Four] [Six]** alternate layers of **[galvanized-steel] [aluminum] [stainless-steel]** flat and herringbone-crimp screen.
1. Nonoilied for grease removal application.
 2. Adhesive coating.
 - a. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Filter-Media Frame: **[Galvanized steel] [Hot-dip galvanized steel] [Aluminum] [Stainless steel]**, hinged, and with pull and retaining handles fastened to the media.
1. Drain holes.
- D. Capacities and Characteristics:
1. Face Area: **<Insert sq. in. (sq. mm)>**.
 2. Face Dimensions: **<Insert inches (mm)>**.
 3. Thickness or Depth: **<Insert inches (mm)>**.
 4. Surface Area: **<Insert sq. ft. (sq. m)>**.

5. Holding Frame Size: <Insert inches (mm)>.
6. Number of Filters: <Insert number>.
7. System Airflow: <Insert cfm (L/s)>.
8. Maximum or Rated Face Velocity: <Insert fpm (m/s)>.
9. Efficiency: 90 percent on particles 20 micrometers and larger at 500 fpm (2.5 m/s).
10. Arrestance: <Insert percentage>.
11. Initial Resistance: <Insert inches wg (Pa)>.
12. Recommended Final Resistance: <Insert inches wg (Pa)>.

2.2 FLAT PANEL FILTERS

- A. Description: Factory-fabricated, self-supported, flat, nonpleated, panel-type, disposable air filters with holding frames.
1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
 - d. Columbus Industries, Inc.
 - e. CRS Industries, Inc.; CosaTron Division.
 - f. D-Mark.
 - g. Filtration Group.
 - h. Flanders-Precisionaire.
 - i. Koch Filter Corporation.
 - j. Purafil, Inc.
 - k. Research Products Corp.
 - l. Tri-Dim Filter Corporation.
 - m. **<Insert manufacturer's name>**.
- B. Filter Unit Class: UL 900, **[Class 1] [Class 2]**.
- C. Media: **[Interlaced glass or synthetic fibers] [Cotton and synthetic fibers]** coated with nonflammable adhesive.
1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Media shall be coated with an antimicrobial agent.
 3. Metal Retainer: Upstream side and downstream side.
- D. Filter-Media Frame: **[Cardboard with perforated metal retainer] [Galvanized steel with metal grid on outlet side and steel rod grid on inlet side, hinged, with pull and retaining handles]** sealed or bonded to the media.

- E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- F. Capacities and Characteristics:
 - 1. Face Area: <Insert **sq. in.** (**sq. mm**)>.
 - 2. Face Dimensions: <Insert **inches** (**mm**)>.
 - 3. Depth: <Insert **inches** (**mm**)>.
 - 4. System Airflow: <Insert **cfm** (**L/s**)>.
 - 5. Maximum or Rated Face Velocity: <Insert **fpm** (**m/s**)>.
 - 6. Arrestance: [85] <Insert **number**> percent when tested according to ASHRAE 52.1.
 - 7. MERV Rating: [6] <Insert **number**> when tested according to ASHRAE 52.2.

2.3 PLEATED PANEL FILTERS

- A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.
 - 1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** <Insert **manufacturer's name; product name or designation**> or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
 - d. Columbus Industries, Inc.
 - e. CRS Industries, Inc.; CosaTron Division.
 - f. D-Mark.
 - g. Filtration Group.
 - h. Flanders-Precisionaire.
 - i. Koch Filter Corporation.
 - j. Purafil, Inc.
 - k. Research Products Corp.
 - l. Tri-Dim Filter Corporation.
 - m. <Insert **manufacturer's name**>.
- B. Filter Unit Class: UL 900, **[Class 1]** **[Class 2]**.
- C. Media: **[Interlaced glass or synthetic fibers]** **[Cotton and synthetic fibers]** coated with nonflammable adhesive.
 - 1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Media shall be coated with an antimicrobial agent.
 - 3. Separators shall be bonded to the media to maintain pleat configuration.
 - 4. Welded wire grid shall be on downstream side to maintain pleat.
 - 5. Media shall be bonded to frame to prevent air bypass.

6. Support members on upstream and downstream sides to maintain pleat spacing.
- D. Filter-Media Frame: [**Cardboard frame with perforated metal retainer**] [**Galvanized steel**] [**Aluminized steel**] [**with metal grid on outlet side and steel rod grid on inlet side, hinged, with pull and retaining handles**] sealed or bonded to the media.
- E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- F. Capacities and Characteristics:
 1. Face Area: **<Insert sq. in. (sq. mm)>**.
 2. Face Dimensions: **<Insert inches (mm)>**.
 3. Thickness or Depth: [**1 inch (25 mm)**] [**2 inches (50 mm)**] [**4 inches (100 mm)**].
 4. Surface Area: **<Insert sq. ft. (sq. m)>**.
 5. Holding Frame Size: **<Insert inches (mm)>**.
 6. Number of Filters: **<Insert number>**.
 7. System Airflow: **<Insert cfm (L/s)>**.
 8. Maximum or Rated Face Velocity: **<Insert fpm (m/s)>**.
 9. Efficiency: 90 percent on particles 20 micrometers and larger at **500 fpm (2.5 m/s)**.
 10. Arrestance: [**85**] **<Insert number>** percent when tested according to ASHRAE 52.1.
 11. Initial Resistance: [**0.25-inch wg (62 Pa)**] [**0.35-inch wg (87.2 Pa)**] [**0.45-inch wg (112 Pa)**] [**0.60-inch wg (150 Pa)**] **<Insert value>** at [**350 fpm (1.8 m/s)**] [**500 fpm (2.5 m/s)**].
 12. Recommended Final Resistance: **<Insert inches wg (Pa)>**.
 13. MERV Rating: [**7**] [**11**] [**13**] [**14**] **<Insert number>** when tested according to ASHRAE 52.2.

2.4 NONSUPPORTED BAG FILTERS

- A. Description: Factory-fabricated, dry, extended-surface, nonsupported filters with header frames.
 1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
 - d. Flanders-Precisionaire.
 - e. Koch Filter Corporation.
 - f. Purafil, Inc.
 - g. Research Products Corp.
 - h. Tri-Dim Filter Corporation.
 - i. **<Insert manufacturer's name>**.

- B. Filter Unit Class: UL 900, [**Class 1**] [**Class 2**].
- C. Media: [**Glass-fiber**] [**Synthetic**] material constructed so individual pockets are maintained in tapered form under rated-airflow conditions by flexible internal supports.
 - 1. Media shall be coated with an antimicrobial agent.
- D. Filter-Media Frame: [**Galvanized steel**] [**Hard polyurethane foam**].
- E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- F. Capacities and Characteristics:
 - 1. Face Area: <Insert **sq. in. (sq. mm)**>.
 - 2. Face Dimensions: <Insert **inches (mm)**>.
 - 3. Thickness or Depth: <Insert **inches (mm)**>.
 - 4. Surface Area: <Insert **sq. ft. (sq. m)**>.
 - 5. Holding Frame Size: <Insert **inches (mm)**>.
 - 6. Number of Filters: <Insert **number**>.
 - 7. System Airflow: <Insert **cfm (L/s)**>.
 - 8. Maximum or Rated Face Velocity: <Insert **fpm (m/s)**>.
 - 9. Efficiency: 90 percent on particles 20 micrometers and larger at **500 fpm (2.5 m/s)**.
 - 10. Arrestance: [**55**] [**65**] [**85**] [**95**] <Insert **number**> percent when tested according to ASHRAE 52.1.
 - 11. Initial Resistance: <Insert **inches wg (Pa)**>.
 - 12. Recommended Final Resistance: <Insert **inches wg (Pa)**>.
 - 13. MERV Rating [**8**] [**10**] [**12**] [**15**] <Insert **number**> when tested according to ASHRAE 52.2.

2.5 RIGID CELL BOX FILTERS

- A. Description: Factory-fabricated, [**adhesive-coated**,]disposable, packaged air filters with media perpendicular to airflow, and with holding frames.
 - 1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <Insert **manufacturer's name; product name or designation**> or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
 - d. Columbus Industries, Inc.
 - e. CRS Industries, Inc.; CosaTron Division.
 - f. D-Mark.
 - g. Filtration Group.
 - h. Flanders-Precisionaire.

- i. Koch Filter Corporation.
 - j. Purafil, Inc.
 - k. Research Products Corp.
 - l. Tri-Dim Filter Corporation.
 - m. **<Insert manufacturer's name>**.
- B. Filter Unit Class: UL 900, **[Class 1]** **[Class 2]**.
- C. Media: Fibrous material constructed so individual pleats are maintained in tapered form under rated-airflow conditions by flexible internal supports.
 - 1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Media shall be coated with an antimicrobial agent.
- D. Filter-Media Frames: **[Galvanized steel]** **[Hard polyurethane foam]**.
- E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- F. Capacities and Characteristics:
 - 1. Face Area: **<Insert sq. in. (sq. mm)>**.
 - 2. Face Dimensions: **<Insert inches (mm)>**.
 - 3. Thickness or Depth: **<Insert inches (mm)>**.
 - 4. Surface Area: **<Insert sq. ft. (sq. m)>**.
 - 5. System Airflow: **<Insert cfm (L/s)>**.
 - 6. Maximum or Rated Face Velocity: **<Insert fpm (m/s)>**.
 - 7. Arrestance: **[85]** **<Insert number>** percent when tested according to ASHRAE 52.1.
 - 8. Initial Resistance: **<Insert inches wg (Pa)>**.
 - 9. Recommended Final Resistance: **<Insert inches wg (Pa)>**.
 - 10. MERV Rating: **[6]** **[8]** **<Insert number>** when tested according to ASHRAE 52.2.

2.6 V-BANK CELL FILTERS

- A. Description: Factory-fabricated, **[adhesive-coated]**, disposable, packaged air filters with media angled to airflow, and with holding frames.
 - 1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following]** **[available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]**:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
 - d. Columbus Industries, Inc.
 - e. CRS Industries, Inc.; CosaTron Division.

- f. D-Mark.
 - g. Filtration Group.
 - h. Flanders-Precisionaire.
 - i. Koch Filter Corporation.
 - j. Purafil, Inc.
 - k. Research Products Corp.
 - l. Tri-Dim Filter Corporation.
 - m. **<Insert manufacturer's name>**.
- B. Filter Unit Class: UL 900, **[Class 1]** **[Class 2]**.
- C. Media: Fibrous material constructed so individual pleats are maintained in tapered form under rated-airflow conditions by flexible internal supports.
 - 1. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Media shall be coated with an antimicrobial agent.
- D. Filter-Media Frames: **[Galvanized steel]** **[Hard polyurethane foam]**.
- E. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- F. Capacities and Characteristics:
 - 1. Face Area: **<Insert sq. in. (sq. mm)>**.
 - 2. Face Dimensions: **<Insert inches (mm)>**.
 - 3. Thickness or Depth: **<Insert inches (mm)>**.
 - 4. Surface Area: **<Insert sq. ft. (sq. m)>**.
 - 5. System Airflow: **<Insert cfm (L/s)>**.
 - 6. Maximum or Rated Face Velocity: **<Insert fpm (m/s)>**.
 - 7. Arrestance: **[85]** **<Insert number>** percent when tested according to ASHRAE 52.1.
 - 8. Initial Resistance: **<Insert inches wg (Pa)>**.
 - 9. Recommended Final Resistance: **<Insert inches wg (Pa)>**.
 - 10. MERV Rating: **[6]** **[8]** **<Insert number>** when tested according to ASHRAE 52.2.

2.7 SELF-SUPPORTED POCKET FILTERS

- A. Description: Factory-fabricated, panel-type, disposable air filters with contoured media for extended surface.
 - 1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following]** **[available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]**:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.

- c. Columbus Industries, Inc.
 - d. Filtration Group.
 - e. Flanders-Precisionaire.
 - f. Koch Filter Corporation.
 - g. **<Insert manufacturer's name>**.
- B. Filter Unit Class: UL 900, [**Class 1**] [**Class 2**].
- C. Media: Fibrous material constructed so individual pleats are maintained in tapered form under rated-airflow conditions by flexible internal supports.
 - 1. Media shall be coated with an antimicrobial agent.
- D. Configuration: [**Single-pocket cube**] [**Multipocket**].
- E. Filter-Media Frame: [**Galvanized steel**] [**Hard polyurethane foam**].
- F. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- G. Capacities and Characteristics:
 - 1. Face Dimensions: **<Insert inches (mm)>**.
 - 2. Thickness or Depth: **<Insert inches (mm)>**.
 - 3. Surface Area: **<Insert sq. ft. (sq. m)>**.
 - 4. System Airflow: **<Insert cfm (L/s)>**.
 - 5. Maximum or Rated Face Velocity: **<Insert fpm (m/s)>**.
 - 6. Arrestance: [**85**] **<Insert number>** percent when tested according to ASHRAE 52.1.
 - 7. Initial Resistance: **<Insert inches wg (Pa)>**.
 - 8. Recommended Final Resistance: **<Insert inches wg (Pa)>**.
 - 9. MERV Rating: [**6**] [**8**] **<Insert number>** when tested according to ASHRAE 52.2.

2.8 FRONT- AND REAR-ACCESS FILTER FRAMES

- A. Framing System: [**Galvanized-steel**] [**Aluminum**] framing members with access for either upstream (front) or downstream (rear) filter servicing, cut to size and prepunched for assembly into modules. Vertically support filters to prevent deflection of horizontal members without interfering with either filter installation or operation.
 - 1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
 - d. Columbus Industries, Inc.

- e. CRS Industries, Inc.; CosaTron Division.
- f. D-Mark.
- g. Filtration Group.
- h. Flanders-Precisionaire.
- i. Koch Filter Corporation.
- j. Purafil, Inc.
- k. Research Products Corp.
- l. **<Insert manufacturer's name>**.

- B. Prefilters: Incorporate a separate track[**with spring clips**], removable from front[**or back**].
- C. Sealing: Factory-installed, positive-sealing device for each row of filters, to ensure seal between gasketed filter elements and to prevent bypass of unfiltered air.

2.9 SIDE-SERVICE HOUSINGS

- A. Description: Factory-assembled, side-service housings, constructed of [**galvanized steel**] [**aluminum**] with flanges to connect to duct or casing system.
 - 1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. AAF International.
 - b. Airguard.
 - c. Camfil Farr.
 - d. Columbus Industries, Inc.
 - e. CRS Industries, Inc.; CosaTron Division.
 - f. D-Mark.
 - g. Filtration Group.
 - h. Flanders-Precisionaire.
 - i. Koch Filter Corporation.
 - j. Purafil, Inc.
 - k. Research Products Corp.
 - l. **<Insert manufacturer's name>**.
- B. Prefilters: Integral tracks to accommodate **2-inch- (50-mm-)** deep, disposable [**or washable**] filters.
- C. Access Doors: [**Hinged, with continuous**] [**Continuous**] gaskets on perimeter and positive-locking devices, and arranged so filter cartridges can be loaded from either access door.
- D. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames and to prevent bypass of unfiltered air.

2.10 FILTER GAGES

- A. Diaphragm-type gage with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.
1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. Airguard.
 - b. Dwyer Instruments, Inc.
 - c. **<Insert manufacturer's name>**.
 3. Diameter: **[4-1/2 inches (115 mm)] [2 inches (50 mm)]**.
 4. Scale Range for Filter Media Having a Recommended Final Resistance of **0.5-Inch wg (125 Pa)** or Less: **0- to 0.5-inch wg (0 to 125 Pa)**.
 5. Scale Range for Filter Media Having a Recommended Final Resistance of **0.5- to 1.0-Inch wg (125 to 250 Pa)** or Less: **0- to 1.0-inch wg (0 to 250 Pa)**.
 6. Scale Range for Filter Media Having a Recommended Final Resistance of **1.0- to 2.0-Inch wg (250 to 500 Pa)** or Less: **0- to 2.0-inch wg (0 to 500 Pa)**.
 7. Scale Range for Filter Media Having a Recommended Final Resistance of **2.0- to 3.0-Inch wg (500 to 750 Pa)** or Less: **0- to 3.0-inch wg (0 to 750 Pa)**.
 8. Scale Range for Filter Media Having a Recommended Final Resistance of **3.0- to 4.0-Inch wg (750 to 1000 Pa)** or Less: **0- to 4.0-inch wg (0 to 1000 Pa)**.
- B. Manometer-Type Filter Gage: Molded plastic, with epoxy-coated aluminum scale and logarithmic-curve tube gage with integral leveling gage, graduated to read from **0- to 3.0-inch wg (0 to 750 Pa)**, and accurate within 3 percent of the full scale range.
- C. Accessories: Static-pressure tips, tubing, gage connections, and mounting bracket.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- B. Install filters in position to prevent passage of unfiltered air.
- C. Install filter gage for each filter bank.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

- E. Install filter-gage, static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.
- F. Coordinate filter installations with duct and air-handling-unit installations.

3.2 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. Test for leakage of unfiltered air while system is operating.
- C. Air filter will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.3 CLEANING

- A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 234100

SECTION 23 54 00 - FURNACES & DX SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gas Fired Furnaces.
 - 2. Evaporator Coil Units.
 - 3. Condensing Units.
 - 4. Thermostats.
- B. Related Sections:
 - 1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
 - 2. Section 22 11 23 - Facility Natural-Gas Piping: Execution requirements for natural gas piping specified in this section.
 - 3. Section 23 31 00 - HVAC Ducts and Casings: Execution requirements for ductwork and duct liner specified by this section.
 - 4. Section 23 33 00 - Air Duct Accessories: Execution requirements for flexible duct connections specified by this section.
 - 5. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI Z83.9 - Gas-Fired Duct Furnaces.
- B. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - 2. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
 - 2. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 3. ASHRAE 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers.
- D. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- E. National Fire Protection Association:
 - 1. NFPA 54 - National Fuel Gas Code.
 - 2. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 3. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
 - 4. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances.
- F. Underwriters Laboratories Inc.:

1. UL 207 - Refrigerant-Containing Components and Accessories, Nonelectrical.

G. United States Department of Energy:

1. DOE 10 CFR - Uniform Test Method for Measuring the Energy Consumption of Furnaces.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittals procedures.
- B. Product Data: Submit rated capacities, efficiencies, weights, required clearances, and location and size of field connections, accessories, electrical nameplate data, and wiring diagrams.
- C. Design Data: Indicate refrigerant pipe sizing.
- D. Manufacturer's Installation Instructions: Submit rigging, assembly, and installation instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and connections.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, service instructions, installation instructions, maintenance and repair data, and parts listing.

1.5 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements : Product storage and handling requirements.
- B. Accept furnaces, humidifiers, electronic air cleaners, condensing units and thermostats on site in factory packaging. Inspect for damage.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not install condensing unit foundation pad when ground is frozen or muddy.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.10 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of furnace and accessories for one year from Date of Substantial Completion.
- C. Include systematic examination, adjustment, and lubrication. Repair or replace parts whenever required. Use parts produced by manufacturer of original equipment.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish spare filters.

PART 2 PRODUCTS

2.1 GAS FIRED FURNACES

- A. Manufacturers:
 - 1. Carrier
 - 2. Trane
 - 3. York
- B. General Description:
 - 1. Furnish and install a 4-way multi-poise gas fired condensing furnace for use with natural gas; furnish cold air return plenum, furnish external media cabinet for use with standard filter.
- C. Blower Wheel and ECM Blower Motor: Galvanized blower wheel shall be centrifugal type, statically and dynamically balanced. Blower motor of ECM type shall be permanently lubricated with sealed ball bearings, and have infinitely variable speed from 250-1300 RPM operating only when 24 VAC motor inputs are provided. Blower motor shall be direct drive and soft mounted to the blower scroll to reduce vibration transmission.
- D. Filters: Furnace shall have re-usable type filters. Filters shall be size compatible with unit.
- E. Casing: Casing shall be 0.030 inch thickness minimum, pre-painted galvanized steel.
- F. ECM Inducer Motor: Shall be variable speed design, soft mounted to assembly to reduce vibration transmission.
- G. Primary Heat Exchangers: Shall be 3-pass 20 gauge corrosion resistant aluminized steel of fold and crimp sectional design and applied operating under negative pressure.

- H. Secondary Heat Exchanger: Shall be of a flow-through design having a patented interior laminate coating of polypropylene for greater corrosion resistance with fold and crimp design and applied operating under negative pressure.
- I. Controls:
 - 1. Micro-processor based integrated control board with at least 16 service trouble shooting codes displayed via diagnostic flashing LED light on the control, a self-test feature that checks all major functions of the furnace, and a replaceable automotive type circuit protection fuse.
 - 2. Multiple operational settings available, including separate blower speeds for low heat, medium heat, high heat, low cooling, high cooling, and continuous fan.
 - 3. Continuous fan speed may be adjusted from the thermostat.
 - 4. Cooling airflow will be selectable between 350 or 400 cfm per ton of air conditioning.
 - 5. Features shall also include temporary reduced airflow in the cooling mode with "Infinity" (or equal) control.

2.2 EVAPORATOR COILS

- A. Manufacturers:
 - 1. Carrier
 - 2. Trane
 - 3. York
- B. Construction and Ratings: In accordance with ARI 210/240.
- C. Evaporator Coil: Copper tube aluminum fin assembly, galvanized or polymeric drain pan, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve, steel cabinet with baked enamel finish and insulation.

2.3 CONDENSING UNITS

- A. Manufacturers:
 - 1. Carrier
 - 2. Trane
 - 3. York
- B. General Description:
 - 1. Outdoor mounted, air cooled, split system air conditioner suitable for ground installation.
 - 2. Unit consists of a hermetic compressor, an air cooled coil, propeller type condenser fan, and a control box.
 - 3. Unit will discharge supply air upward.
 - 4. Unit will be used in a refrigeration circuit to match up to an evaporator coil unit.
- C. Refrigerant: R-410A, "Puron".
- D. Unit Cabinet: Unit cabinet shall be constructed of galvanized steel, bonderized, and coated with a powder coat paint.
- E. Fans: Condenser fan will be direct drive propeller type, discharging air upward.
 - 1. Condenser fan motor will be totally enclosed, single phase type with class B insulation and permanently lubricated bearings.
 - 2. Motor shaft shall be corrosion resistant.

3. Fan blades shall be statically and dynamically balanced.
 4. Condenser fan opening will be equipped with PVC coated steel wire safety guards.
- F. Compressor: Shall be hermetically sealed and mounted on rubber vibration isolators.
- G. Condenser Coil: Shall be air cooled, constructed of aluminum fins mechanically bonded to copper tubes which are cleaned, dehydrated, and sealed.
- H. Refrigerant Components:
1. Liquid line shutoff valve with sweat connections
 2. Vapor line shutoff valve with sweat connections
 3. System charge of R410A
 4. Compressor oil
 5. Unit shall be equipped with factory supplied high pressure switch, and filter drier.
- 2.4 THERMOSTATS
- A. Manufacturers:
1. Carrier
 2. Trane
 3. Approved Equivalent
- B. Adjustable Room Thermostat: Low voltage, seven day programmable with fan/heat/cool settings, compatible with furnace and condensing unit combination.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

3.2 INSTALLATION

- A. Install gas fired furnaces in accordance with NFPA 54.
- B. Install vent connections in accordance with NFPA 211 and NFPA 54.
- C. Install refrigeration systems in accordance with ASHRAE 15.
- D. Mount down-flow furnaces installed on combustible floors on combustible-floor base.
- E. Mount air cooled condenser-compressor package on concrete pads
- F. Installation - Natural Gas Piping:
1. Connect natural gas piping in accordance with NFPA 54.
 2. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.
 3. Install the following piping accessories on natural gas piping connections.
 - a. Strainer.
 - b. Pressure gage.
 - c. Shutoff valve.

- d. Pressure reducing valve.
- G. Pipe drain from cooling coils and gas-fired furnaces heat exchanger and vent condensate disposal to nearest floor drain,
- H. Connect units to electric supply and connect controls remote from units.
- I. Install control components supplied with equipment and provide control wiring.
- J. Install control wiring between thermostat, indoor unit, and outdoor unit.
- K. Install evaporator unit in section of lined ductwork fastened to furnace. Connect return air and evaporator unit duct to system ductwork with flexible duct connection.

END OF SECTION

SECTION 23 63 13 - AIR-COOLED REFRIGERANT CONDENSERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes packaged, air-cooled refrigerant condensers for [outdoor] [indoor] installation.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1-2004.
 - 2. Product Data for Credit EA 4: Documentation indicating that air-cooled refrigerant condensers and refrigerants comply.
- C. Shop Drawings: For air-cooled refrigerant condensers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**

- B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
1. Carrier Corporation; Commercial HVAC Systems.
 2. Colmac Coil Manufacturing, Inc.
 3. Coolenheat Inc.
 4. Dunham-Bush, Inc.
 5. Engineered Air.
 6. Heatcraft Refrigeration Products LLC.
 7. McQuay International.
 8. Trane; a business of American Standard Companies.
 9. USA Coil & Air.
 10. YORK; a Johnson Controls company.
 11. **<Insert manufacturer's name>**.

2.2 MANUFACTURED UNITS

- A. Description: Factory assembled and tested; consisting of casing, condenser coils, condenser fans and motors, and unit controls.
- B. Refrigerant: [**R-22**] [**R-407C**] [**R-410A**] **<Insert type>**.
- C. Refrigerant: R-407C or R-410A.
- D. Condenser Coil: Factory tested at **425 psig (2930 kPa)**.
1. Tube: [**1/2-inch- (13-mm-)** diameter seamless copper.] [**3/8-inch- (10-mm-)** diameter seamless copper.] [**5/8-inch- (16-mm-)** diameter seamless copper.] [**5/8-inch- (16-mm-)** diameter steel.]
 2. Coil Fin: [**Aluminum**] [**Steel**].
 3. Coating: [**Thermoplastic vinyl**] [**Epoxy**] [**Zinc**] [**Synthetic resin**] [**Phenolic**] [**Polytetrafluoroethylene**] [**Vinyl ester**] [**Hot-dip galvanized**] [**Powder-baked enamel**]; **<Insert manufacturer's name; trade name>**.
 4. Circuit: To match compressors[**with liquid subcooling coil**].
- E. Condenser Fans and Drives: Propeller fans with [**aluminum or galvanized-steel**] [**galvanized-steel**] [**stainless-steel**] fan blades, for [**vertical**] [**horizontal**] air discharge; directly driven with [**permanently lubricated**] [**grease-lubricated**] ball-bearing motors with integral current- and thermal-overload protection.
1. Weather-proof motors with rain shield and shaft slinger.
 2. Extend grease lines to outside of casing.
- F. Condenser Fans and Drives: Forward-curved centrifugal fans for [**vertical**] [**horizontal**] air discharge.
1. Fan on steel shaft with self-aligning ball bearings.
 2. V-belt drive with minimum of two belts; variable pitch drive pulley.
 3. Motor mounted on adjustable slide base.

- G. Operating and Safety Controls: Include condenser fan motor thermal and overload cutouts; 115-V control transformer, if required; magnetic contactors for condenser fan motors and a nonfused factory-mounted and -wired disconnect switch for single external electrical power connection.
 - 1. Fan Cycling Control: [**Head pressure switches**] [**Ambient thermostats**].
- H. Casings: [**Galvanized or zinc-coated steel treated and finished with manufacturer's standard paint coating**] [**Aluminum**] [**Stainless steel**], designed for **outdoor installation with weather protection for components and controls**, and with the following:
 - 1. Removable panels for access to controls, condenser fans, motors, and drives.
 - 2. [**Plated**] [**Stainless**]-steel fan guards.
 - 3. Lifting eyes.
 - 4. Removable legs, [**20 inches (500 mm)**] [**30 inches (760 mm)**] [**36 inches (910 mm)**] [**42 inches (1060 mm)**] high.

2.3 CAPACITIES AND CHARACTERISTICS

- A. Heat-Rejection Capacity: <Insert **MBh (kW)**>.
- B. Condensing Temperature:
 - 1. Saturated Discharge Temperature: <Insert **deg F (deg C)**>.
 - 2. Saturated Suction Temperature: <Insert **deg F (deg C)**>.
 - 3. Subcooling Temperature: <Insert **deg F (deg C)**>.
- C. Ambient-Air Temperature: <Insert **deg F (deg C)**>.
- D. Refrigerant Pipe Connections:
 - 1. Number of Connections: <Insert **number**>.
 - 2. Liquid Pipe Size: <Insert **NPS (DN)**>.
 - 3. Suction Pipe Size: <Insert **NPS (DN)**>.
- E. Coils:
 - 1. Arrangement: <Insert **description**>.
 - 2. Number of Rows: <Insert **number**>.
 - 3. Fin Spacing: [**12 fins/inch (2 mm)**] <Insert **value**>.
 - 4. Total Face Area: <Insert **sq. ft. (sq. m)**>.
- F. Fans:
 - 1. Number of Condenser Fans: <Insert **number**>.
 - 2. Diameter: <Insert **inches (mm)**>.
 - 3. RPM: <Insert **number**>.
 - 4. Total Airflow: <Insert **cfm (L/s)**>.
 - 5. Condenser Fan Motor Size: <Insert **horsepower**>.

G. Electrical Characteristics:

1. Kilowatts: **<Insert value>**.
2. Volts: **<Insert value>**.
3. Phase: **<Insert value>**.
4. Hertz: **<Insert value>**.
5. Maximum Circuit Ampacity: **<Insert value>**.
6. Maximum Instantaneous Current Flow during Startup: **<Insert value>**.
7. Maximum Overcurrent Protection: **<Insert amperage>**.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Enclosure Type: Totally enclosed, fan cooled.
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 Division 26 Sections.
4. Mount unit-mounted disconnect switches on **[exterior]** **[interior]** of unit.
5. **<Insert unique motor characteristics>**.

2.5 SOURCE QUALITY CONTROL

A. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
- B. Equipment Mounting: Install air-cooled condenser refrigerant condensers using **[elastomeric pads]** **[elastomeric mounts]** **[restrained spring isolators]** **<Insert device>**. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
1. Minimum Deflection: **[1/4 inch (6 mm)]** **[1 inch (25 mm)]** **<Insert dimension>**.
- C. Equipment Mounting: Install air-cooled condenser refrigerant condensers with **<Insert seismic-restraint device>**. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Maintain manufacturer's recommended clearances for service and maintenance.

- E. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Refrigerant Piping: Connect piping to unit with pressure relief, service valve, filter-dryer, and moisture indicator on each refrigerant-circuit liquid line. Refrigerant piping and specialties are specified in Division 23 Section "Refrigerant Piping."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Perform electrical test and visual and mechanical inspection.
 - 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 proper motor rotation and unit operation. Complete manufacturer's starting checklist.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 5. Verify proper airflow over coils.
- C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- D. Air-cooled refrigerant condensers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 236313

SECTION 23 72 00 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Heat wheels.
2. Fixed-plate sensible heat exchangers.
3. Fixed-plate total heat exchangers.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Seismic Performance: Air-to-air energy recovery equipment shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] **<Insert requirement>**.
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**]."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
- C. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.
- D. Delegated-Design Submittal: For air-to-air energy recovery equipment 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 air-to-air energy recovery equipment.

2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 3. Design Calculations: Calculate requirements for selecting vibration isolators[**and seismic restraints**] and for designing vibration isolation bases.
- E. Seismic Qualification Certificates: For air-to-air energy recovery equipment, accessories, and components, from manufacturer.
- F. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ARI Compliance:
1. Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."
 2. Capacity ratings for air coils shall comply with ARI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils."
- C. ASHRAE Compliance:
1. Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
 2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."
- D. UL Compliance:
1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."
 2. Electric coils shall comply with requirements in UL 1995, "Heating and Cooling Equipment."

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Fixed-Plate Total Heat Exchangers: [10] **<Insert number>** years.
 2. **<Insert components requiring extended warranty>**.

PART 2 - PRODUCTS

2.1 HEAT WHEELS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - 1. Advanced Thermal Technologies.
 - 2. Airxchange Inc.
 - 3. American Energy Exchange, Inc.
 - 4. Loren Cook Company.
 - 5. SEMCO Incorporated.
 - 6. Trane; American Standard Companies, Inc.
 - 7. **<Insert manufacturer's name>**.
- C. Casing:
 - 1. Steel with standard factory-painted finish.
 - 2. Integral purge section limiting carryover of exhaust air to between **[0.05 percent at 1.6-inch wg and 0.20 percent at 4-inch wg (0.05 percent at 400-Pa and 0.20 percent at 1000-Pa)]** **<Insert value>** differential pressure.
 - 3. Casing seals on periphery of rotor and on duct divider and purge section.
 - 4. Support vertical rotors on grease-lubricated ball bearings having extended grease fittings[**or permanently lubricated bearings**]. Support horizontal rotors on tapered roller bearing.
- D. Rotor: Aluminum segmented wheel strengthened with radial spokes[, **with nontoxic, noncorrosive, silica-gel desiccant coating**].
 - 1. Maximum Solid Size for Media to Pass: **[500] [800] [1200]** micrometer.
- E. Rotor: **[Glass-fiber] [Polymer]** segmented wheel strengthened with radial spokes impregnated with nonmigrating, water-selective, molecular-sieve desiccant coating.
 - 1. Maximum Solid Size for Media to Pass: **[800] [1200]** micrometer.
- F. Drive: Fractional horsepower motor and gear reducer[, **with speed changed by variable frequency controller**] and self-adjusting multilink belt around outside of rotor.
 - 1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 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.

G. Controls:

1. Starting relay, factory mounted and wired, and manual motor starter for field wiring.
2. Variable frequency controller, factory mounted and wired, with exhaust- and outdoor-air sensors, automatic changeover thermostat and set-point adjuster, to vary rotor speed and maintain[**exhaust temperature above freezing and**] air differential temperature above set point. Rotor speed shall increase to maximum when exhaust-air temperature is less than outdoor-air temperature.
3. Pilot-Light Indicator: Display rotor rotation and speed.
4. Speed Settings: Adjustable settings for maximum and minimum rotor speed limits.

H. Disposable Panel Filters:

1. Comply with NFPA 90A.
2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
3. Factory-fabricated, viscous-coated, flat-panel type.
4. Thickness: [1 inch (25 mm)] [2 inches (50 mm)].
5. Dust-Holding Capacity: <Insert lb (kg)>.
6. Initial Resistance: <Insert inches wg (Pa)>.
7. Recommended Final Resistance: <Insert inches wg (Pa)>.
8. Minimum Arrestance: [80] <Insert value>, according to ASHRAE 52.1.
9. Minimum Merv: [5] <Insert value>, according to ASHRAE 52.2.
10. Media: Interlaced glass fibers sprayed with nonflammable adhesive[**and antimicrobial agent**].
11. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

I. Extended-Surface, Disposable Panel Filters:

1. Comply with NFPA 90A.
2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
3. Factory-fabricated, dry, extended-surface type.
4. Thickness: [1 inch (25 mm)] [2 inches (50 mm)] [4 inches (100 mm)].
5. Dust-Holding Capacity: <Insert lb (kg)>.
6. Initial Resistance: <Insert inches wg (Pa)>.
7. Recommended Final Resistance: <Insert inches wg (Pa)>.
8. Minimum Arrestance: [90] <Insert value>, according to ASHRAE 52.1.
9. Minimum Merv: [7] <Insert value>, according to ASHRAE 52.2.
10. Media: Fibrous material formed into deep-V-shaped pleats[**with antimicrobial agent**] and held by self-supporting wire grid.
11. Media-Grid Frame: [Nonflammable cardboard] [Galvanized steel] [Fire-retardant, 3/4-inch (20-mm) particleboard with gaskets].
12. Mounting Frames: Welded, galvanized steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.2 FIXED-PLATE SENSIBLE HEAT EXCHANGERS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - 1. American Energy Exchange, Inc.
 - 2. Des Champs Technologies.
 - 3. Eclipse, Inc.; Exothermics Business Group.
 - 4. Nutech Brands Inc.
 - 5. RenewAire LLC.
 - 6. UAS, Inc.; a CLARCOR company.
 - 7. **<Insert manufacturer's name>**.
- C. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Casing: **[Aluminum] [Galvanized steel] [Enameled steel, with galvanized-steel liner] [Enameled steel]** with duct collars.
- E. Casing Insulation: **[1/2-inch- (13-mm-) thick, foil-faced glass fiber] [1-inch- (25-mm-) thick, foil-faced glass fiber] [1 inch (25 mm) thick, ASTM C 1071 with coated surface] [1 inch (25 mm) thick, fiber free]**.
- F. Drain Pan: **[Same material as casing, with drain connections on exhaust and supply side] [Molded ABS covering bottom of case, with drain connections on exhaust and supply side]**.
 - 1. Comply with requirements in ASHRAE 62.1-2004.
- G. Plates: Evenly spaced and sealed and arranged for counter airflow.
 - 1. Plate Material: **[Embossed aluminum] [Stainless steel] [Polypropylene copolymer (high-density plastic)]**.
 - 2. Plate Coating: **[Epoxy] [Air-dried phenolic]**.
- H. Bypass Plenum: Within casing, with gasketed face-and-bypass dampers having operating rods extended outside casing.
- I. Disposable Panel Filters:
 - 1. Comply with NFPA 90A.
 - 2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
 - 3. Factory-fabricated, viscous-coated, flat-panel type.
 - 4. Thickness: **[1 inch (25 mm)] [2 inches (50 mm)]**.
 - 5. Initial Resistance: **<Insert inches wg (Pa)>**.

6. Recommended Final Resistance: **<Insert inches wg (Pa)>**.
7. Minimum Arrestance: **[80] <Insert value>**, according to ASHRAE 52.1.
8. Minimum Merv: **[5] <Insert value>**, according to ASHRAE 52.2.
9. Media: Interlaced glass fibers sprayed with nonflammable adhesive[**and antimicrobial agent**].
10. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

J. Extended-Surface, Disposable Panel Filters:

1. Comply with NFPA 90A.
2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
3. Factory-fabricated, dry, extended-surface type.
4. Thickness: **[1 inch (25 mm)] [2 inches (50 mm)] [4 inches (100 mm)]**.
5. Initial Resistance: **<Insert inches wg (Pa)>**.
6. Recommended Final Resistance: **<Insert inches wg (Pa)>**.
7. Minimum Arrestance: **[90] <Insert value>**, according to ASHRAE 52.1.
8. Minimum Merv: **[7] <Insert value>**, according to ASHRAE 52.2.
9. Media: Fibrous material formed into deep-V-shaped pleats[**with antimicrobial agent**] and held by self-supporting wire grid.
10. Media-Grid Frame: **[Nonflammable cardboard] [Galvanized steel] [Fire-retardant, 3/4-inch (20-mm) particleboard with gaskets]**.
11. Mounting Frames: Welded, galvanized steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.3 FIXED-PLATE TOTAL HEAT EXCHANGERS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]**:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 1. Mitsubishi Electric Sales Canada Inc.
 2. RenewAire LLC.
 3. **<Insert manufacturer's name>**.
- C. Casing: Galvanized steel.
- D. Plates: Evenly spaced and sealed and arranged for counter airflow.
 1. Plate Material: Chemically treated paper with selective hydroscopicity and moisture permeability, and gas barrier properties.
- E. Bypass Plenum: Within casing, with gasketed face-and-bypass dampers having operating rods extended outside casing.

F. Disposable Panel Filters:

1. Comply with NFPA 90A.
2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
3. Factory-fabricated, viscous-coated, flat-panel type.
4. Thickness: [1 inch (25 mm)] [2 inches (50 mm)].
5. Initial Resistance: <Insert inches wg (Pa)>.
6. Recommended Final Resistance: <Insert inches wg (Pa)>.
7. Minimum Arrestance: [80] <Insert value>, according to ASHRAE 52.1.
8. Minimum Merv: [5] <Insert value>, according to ASHRAE 52.2.
9. Media: Interlaced glass fibers sprayed with nonflammable adhesive[and antimicrobial agent].
10. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

G. Extended-Surface, Disposable Panel Filters:

1. Comply with NFPA 90A.
2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
3. Factory-fabricated, dry, extended-surface type.
4. Thickness: [1 inch (25 mm)] [2 inches (50 mm)] [4 inches (100 mm)].
5. Initial Resistance: <Insert inches wg (Pa)>.
6. Recommended Final Resistance: <Insert inches wg (Pa)>.
7. Minimum Arrestance: [90] <Insert value>, according to ASHRAE 52.1.
8. Minimum Merv: [7] <Insert value>, according to ASHRAE 52.2.
9. Media: Fibrous material formed into deep-V-shaped pleats[with antimicrobial agent] and held by self-supporting wire grid.
10. Media-Grid Frame: [Nonflammable cardboard] [Galvanized steel] [Fire-retardant, 3/4-inch (20-mm) particleboard with gaskets].
11. Mounting Frames: Welded, galvanized steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.4 CAPACITIES AND CHARACTERISTICS

A. Exhaust Air:

1. Airflow: <Insert cfm (L/s)>.
2. Face Velocity: <Insert fpm (m/s)>.
3. Summer:
 - a. Entering-Air Temperature, Dry Bulb: <Insert deg F (deg C)>.
 - b. Entering-Air Temperature, Wet Bulb: <Insert deg F (deg C)>.
 - c. Leaving-Air Temperature, Dry Bulb: <Insert deg F (deg C)>.
 - d. Leaving-Air Temperature, Wet Bulb: <Insert deg F (deg C)>.
4. Winter:

- a. Entering-Air Temperature, Dry Bulb: **<Insert deg F (deg C)>**.
 - b. Entering-Air Temperature, Wet Bulb: **<Insert deg F (deg C)>**.
 - c. Leaving-Air Temperature, Dry Bulb: **<Insert deg F (deg C)>**.
 - d. Leaving-Air Temperature, Wet Bulb: **<Insert deg F (deg C)>**.
 5. Air Pressure Drop: **<Insert inches wg (Pa)>**.
- B. Supply Air:
1. Airflow: **<Insert cfm (L/s)>**.
 2. Face Velocity: **<Insert fpm (m/s)>**.
 3. Summer:
 - a. Entering-Air Temperature, Dry Bulb: **<Insert deg F (deg C)>**.
 - b. Entering-Air Temperature, Wet Bulb: **<Insert deg F (deg C)>**.
 - c. Leaving-Air Temperature, Dry Bulb: **<Insert deg F (deg C)>**.
 - d. Leaving-Air Temperature, Wet Bulb: **<Insert deg F (deg C)>**.
 4. Winter:
 - a. Entering-Air Temperature, Dry Bulb: **<Insert deg F (deg C)>**.
 - b. Entering-Air Temperature, Wet Bulb: **<Insert deg F (deg C)>**.
 - c. Leaving-Air Temperature, Dry Bulb: **<Insert deg F (deg C)>**.
 - d. Leaving-Air Temperature, Wet Bulb: **<Insert deg F (deg C)>**.
 5. Air Pressure Drop: **<Insert inches wg (Pa)>**.
- C. Wheel Drive:
1. Motor Size: **<Insert horsepower>**.
 2. Motor Electrical Characteristics:
 - a. Volts: **[120] [208] [230] <Insert value>**.
 - b. Phase: **[Single] [Three]**.
 - c. Hertz: 60.
- D. Effectiveness: **<Insert percent>**.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install heat wheels so supply and exhaust airstreams flow in opposite directions and rotation is away from exhaust side to purge section to supply side.
 1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
 2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.

3. Access doors and panels are specified in Division 23 Section "Air Duct Accessories."
- B. Install fixed-plate heat exchangers so supply and exhaust airstreams flow in opposite directions.
 1. Install duct access doors in both supply and exhaust ducts, both upstream and downstream, for access to heat exchanger. Access doors and panels are specified in Division 23 Section "Air Duct Accessories."
- C. Install floor-mounted units on **4-inch- (100-mm-)** high concrete base[**designed to withstand, without damage to equipment, seismic force required by code**].
- D. Equipment Mounting: Install air-to-air energy recovery equipment on concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "[**Cast-in-Place Concrete**] [**Miscellaneous Cast-in-Place Concrete**]."
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of concrete base.
 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- E. Suspended Units: Suspend[**and brace**] units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- F. Install units with clearances for service and maintenance.
- G. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- H. Pipe drains from units and drain pans to nearest floor drain; use [**ASTM B 88, Type L (ASTM B 88M, Type B), drawn-temper copper water tubing with soldered joints**] [**ASTM D 1785, Schedule 40 PVC pipe and solvent-welded fittings**], same size as condensate drain connection.
 1. Requirements for Low-Emitting Materials:
 - a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to unit to allow service and maintenance.
- C. Connect piping to units mounted on vibration isolators with flexible connectors.

END OF SECTION 237200

SECTION 23 74 33 - DEDICATED OUTDOOR AIR UNITS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Dedicated Outdoor-Air Units

B. Related Sections:

1. Section 23 05 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Seismic Control for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
6. Section 23 09 00 – Instrumentation and Control for HVAC
7. Section 23 09 93 – Sequence of Operation for HVAC Controls
8. Division 23 11 23 – Facility Natural-Gas Piping
9. Division 26 Sections for electrical connections.

1.02 REFERENCES

A. Air-Conditioning, Heating and Refrigeration Institute (AHRI) Publications:

1. 410 "Forced Circulation Air-Cooling and Air-Heating Coils"
2. 1060 "Performance of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment"

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Publications:

1. 62.1 "Ventilation for Acceptable Indoor Air Quality (ANSI Approved)"
2. 90.1 "Energy Code for Commercial and High-Rise Residential Buildings"

C. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. B117 "Standard Practice for Operating Salt Spray (Fog) Apparatus"

D. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"
2. 90A "Standard for the Installation of Air Conditioning and Ventilating Systems"

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.

1. Product Data including manufacturer's technical data, clearly indicated for each model, including: rated capacities, operating characteristics, dimensions, weights (shipping,

installed, and operating), furnished specialties, accessories, and installation and startup instructions.

2. Shop Drawings from manufacturer detailing equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wiring Diagrams detailing wiring for power, signal, and control systems. Clearly differentiate between manufacturer-installed and field-installed wiring.
4. Commissioning report, including pre-functional testing checklists, indicating the results of unit startup, testing and commissioning requirements.
5. Maintenance data for energy recovery units to include in the operation and maintenance manual specified in Division 01 and in Section 23 05 00 "Common Work Results for HVAC."

1.04 QUALITY ASSURANCE

- A. AHRI Certification: Units and their components shall be factory tested according to the applicable portions of AHRI 1060, "Performance of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment," and AHRI 410, "Forced Circulation Air-Cooling and Air-Heating Coils," and shall be listed and bear the label of the Air-Conditioning, Heating and Refrigeration Institute (AHRI).
- B. UL and NEMA Compliance: Provide motors required as part of air-handling units that are listed and labeled by UL and comply with applicable NEMA standards.
- C. Comply with NFPA 70 for components and installation.
- D. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
 1. The Terms "Listed" and "Labeled": As defined in the NFPA National Electrical Code, Article 100.
- E. Comply with ASHRAE/IESNA Standard 62.1-2004, Section 7 – "Construction and Startup."

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver rooftop units as factory-assembled units with protective crating and covering.
- B. Coordinate delivery of units in sufficient time to allow movement into building.
- C. Handle rooftop units to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

1.06 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described in Section 01 78 43 (01790) "Spare Parts and Materials" that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.08 WARRANTY

- A. General Warranty: The manufacturer shall warrant all equipment for a period of one (1) year from date of substantial completion. Extended warranty 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. Extended Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of rooftop air conditioners that fail in materials or workmanship within specified warranty period.
 - 1. Extended Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 2. Extended Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.
 - 3. Extended Warranty Period for Energy Wheels: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Dedicated Outdoor Air Unit
 - a. Greenheck
 - b. Aeon
 - c. Trane

2.02 DEDICATED OUTDOOR-AIR UNITS (MAKEUP AIR UNITS)

- A. Description: Packaged self-contained, outdoor rooftop, DX/gas, 100% outside air unit of capacities and characteristics as scheduled on the drawings.
 - 1. Each unit shall be completely factory assembled, piped, wired, tested and shipped in one piece.
 - 2. Unit shall be capable of varying the amount of outside air delivered to the space based on occupancy, humidity, indoor air quality and differential pressure.
 - 3. In the event that the space dry bulb temperature begins to deviate from set point, the DOAS shall be capable of varying the outside air supply air temperature to supplement the cooling or heating requirements of the space.
 - 4. Unit shall be capable of varying the moisture content of outside air to the space based on space humidity. To maintain 59 grains of moisture per pound of dry air space conditions, the DOAS must be able deliver air down to 39°F dew point supply air at low air volume conditions.
 - 5. Units shall be designed to cool or dehumidify with entering air temperatures of 45°-110°F and operate in heating mode down to -40°F. Units shall be capable of supplying air with a maximum of 59 grains of moisture per pound of dry air, or less if specified, at both the dry bulb / mean coincidental wet bulb and dew point / mean coincidental dry bulb temperatures at the 0.4% ASHRAE design conditions for the location of the

installation. Units not capable of delivering 59 grains of moisture per pound of dry air, or less if specified, at both design conditions are unacceptable.

6. Units shall provide 100% outdoor air directly to the space, or delivered to the terminal unit(s) supply air duct. Mixed Air units are NOT acceptable.

B. Unit Cabinet:

1. Unit shall be specifically designed for outdoor rooftop application with a fully weatherproof cabinet. The unit roof shall be sloped or cross-broken to assure drainage. Unit base shall overhang the roof curb for water run-off. Rain break overhangs shall be provided above access doors.
2. Cabinet shall be of double wall, insulated design. The cabinet exterior shall be constructed of painted 20 gauge or heavier G90 galvanized steel, or unpainted Type 5052 marine grade aluminum using 12 gauge panels & 8 gauge structural members, or unpainted Type 304 stainless steel using 18 gauge panels & 14 gauge structural members. The interior shall be Type 5052 aluminum or Type 304 stainless of similar gauge to the cabinet exterior. The cabinet shall be weatherproof and suitable for outdoor construction and the entire floor shall be designed to operate as a drain pan so that in the event that rain would enter the cabinet, it will drain via the condensate drain connection. Insulation shall be in accordance with the requirements of ASHRAE Standard 90.1-2004, and shall be non-wicking and moisture resistant. The insulation must not be capable of supporting any biological growth of any kind. All insulation shall have a smoke and fire rating of 5-5 and shall be rated Class A. The insulation shall have a VOC content of zero (0).
3. Paint finish shall be capable of withstanding at least 2500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B117-95 test procedure.
4. Unit shall have insulated, hinged access doors with quarter turn handles and full perimeter gasketed seals. Door fastening screws are not acceptable.
5. Unit shall be factory pre-rigged for a 4-point crane lift.
6. All openings through the base pan of the unit shall have upturned flanges of at least 1/2" in height around the opening through the base pan.
7. Unit shall have a factory-installed cleanable, insulated, double-sloped condensate drain connection of aluminum or stainless steel.
8. Outdoor and exhaust air openings shall have a hood or louver with bird screen. Construction and color shall match cabinet.
9. Dampers:
 - a. Motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 CFM of leakage per sq. ft. of damper area when subjected to 2" w.g. air pressure differential across the damper. [Damper motor shall be spring return to ensure closing of outdoor air damper during periods of unit shut down or power failure. Damper shall be furnished with a 2-position actuator.]
 - b. Gravity type backdraft damper at the exhaust discharge.

10. All evaporator, condenser and water coils shall be cleanable. All coils shall be a maximum of 4 rows thick, 10 fins per inch and include a minimum of a 4 inch clean-out access between coils. The floor below the coil shall be suitable for drainage of the cleaning solution. All coils must be coated in order to reduce corrosion from contaminants from outside air and moisture and increase watershed capability. The coating shall be a thermal set acrylic having an ASTM B117 salt test rating that exceeds 1000 hours. Coatings shall be hydrophobic to aid in draining water from the coil. Interlaced coils shall NOT be acceptable. Units with coils that have more than 10 fins per inch or that have lanced fins are NOT acceptable.
11. Color coded wiring diagrams shall be laminated in plastic and permanently affixed inside the control compartment.
12. Unit shall have decals and tags to indicate unit lifting and rigging, service areas and caution areas.
13. Unit nameplates shall be fixed to the main control panel door.

C. Roof Curb:

1. Roof curb shall be constructed of similar metal as the cabinet construction. Curbs are to be factory welded construction providing full perimeter support, cross structure support and air seal for the unit.

D. Supply Fans:

1. Plenum supply fan shall be backward inclined, direct drive with factory installed variable frequency drive, non-overloading, and designed for high efficiency operation at higher static pressures with lower noise levels. Blowers shall be constructed of epoxy-coated steel for corrosion resistance.
2. Fans shall be statically and dynamically balanced.
3. The fan assembly shall be Blower and motor base is to be mounted on 4 spring and rubber isolators having minimum 3/4-inch deflection. Blower to be isolated from the cabinet with a flexible connector having a 25-50 fire rating.
4. Fan shaft bearings shall be heavy duty, permanently lubricated, self-aligning ball or roller pillow block type. Bearings shall have a minimum life (L-10) of 80,000 hours at maximum operating speed and horsepower for each construction level.

E. Air-Cooled Condenser:

1. The condensing section shall be equipped with vertical discharge, propeller type, direct drive fans with corrosion-resistant blades and supports. Direct drive fans shall be directly connected to and supported by the motor shaft. Fans shall be statically and dynamically balanced.
2. Condenser coils shall have enhanced surface aluminum plate fins mechanically bonded to the copper tubes with all joints brazed.

F. Refrigerant System:

1. Unit shall be factory charged with R-410A refrigerant.
2. Compressors:
 - a. Fully hermetic, scroll type compressors with crankcase heater, overload protection and short cycle protection with minimum on and off timers.

- b. Compressors shall be mounted on the compressor manufacturer's recommended rubber vibration isolators and shall be isolated from the base pan and supply air to avoid transmission of noise from the compressor into the building. Vibrasorb isolators shall be installed in both the suction and discharge tubing of each compressor.
 - c. Compressors shall be mounted in an isolated compartment to permit operation of the unit without affecting air flow when the door to the compartment is open.
 - d. Each compressor shall be individually staged for capacity control. Units exceeding 2,000 cfm shall have a minimum of 3 independent refrigeration circuits that have no shared components. Each circuit must be able to operate at any time without the assistance or aid of any component of the other circuits with the exception of the controls and blower. Any or all components of any single circuit must be constructed in such a way as to be removable without disturbing or disrupting or contaminating any of the other circuits. Each compressor shall be dedicated to an individual evaporator coil, TXV and condenser coil and operate independently. Tandem compressors shall NOT be acceptable. Minimum 2-stage capacity control on units over 10 tons and above.
- 3. Refrigerant System Specialties for each circuit:
 - a. Refrigerant dryer.
 - b. Adjustable thermostatic expansion valve.
 - c. High and low pressure switches.
 - d. Gage connection ports.
 - e. Liquid line sight glass.
 - f. Service/charging valves.
- 4. Capacity Control:
 - a. Multiple compressor design and Variable Speed Digital Scroll compressor design shall provide 0-100% capacity control for continuous dehumidification upon demand. Energy wasting hot gas bypass refrigerant control shall NOT be acceptable.
 - b. Unit shall be equipped with variable speed low ambient head pressure control to allow operation down to 35 F.
- 5. Evaporator coil shall have minimum corrosion potential from dissimilar metals. Coil casing shall be either copper, aluminum, stainless steel. Galvanized steel coil casings shall NOT be acceptable
- 6. Evaporator coil shall be furnished with a double sloped drain pan fabricated of Type 5052 aluminum, or Type 304 stainless steel for the positive drainage of condensate.
- G. Filter Section:
 - 1. Both outdoor and exhaust air streams shall have 4" thick pleated, high efficiency filters with a minimum MERV-13 rating.
- H. Filter Section:
 - 1. Both outdoor and exhaust air streams shall have 2" thick fiberglass filters with a minimum MERV-7 rating.

I. Winter Heating Mode

1. Indirect-Fired Gas Heating:

- a. Gas heating shall be induced-draft combustion type with an energy saving direct spark ignition system and redundant main gas valves.
- b. Heat exchanger shall be tubular section type, constructed of 20 gauge stainless steel.
- c. Burners shall be in-shot type constructed of stainless steel and have sufficient staging as to provide the supply air temperature within 2 degrees (F) of the DOAS supply air setpoint, even at startup, regardless of the entering air temperature. As the supply air volume modulates to meet ventilation demands, the supply air temperature shall not rise above or below the set point temperature, +/- 2 degrees (F).
- d. Gas shall enter the unit at a single location.

J. Controls:

1. Dedicated Outdoor-Air Unit Controller:

- a. The unit shall include a factory installed microprocessor based unit controller which controls the operation of all unit functions including: dampers, supply and exhaust fans, energy recovery wheel, refrigerant system and gas heater.
 - b. Controller shall be capable of the monitoring the following functions, safeties and alarms.
 - 1) Factory-installed dirty filter status for both supply and exhaust filter banks.
 - 2) Factory-installed fan status switch for both supply and exhaust fans.
 - 3) Energy wheel defrost control and air bypass.
 - c. Controller shall be BACNet, Modbus and LonWorks protocol compatible.
 - d. Shall include and alarm indicator and audible alarm signal.
2. Supply air temperature sensor.
 3. Outside air temperature sensor.
 4. Relative humidity sensor.

K. Fire Alarm System Interface:

1. Provide dry contact control interface to connect to fire alarm panel, so that unit shuts down in the event the fire alarm system goes into alarm.

L. Airflow Monitoring/Control & Building Pressure Control:

1. Provide building pressure differential sensor and controls to maintain building pressure at a user adjustable setting (initially set at 0.05" w.g.). The building pressure sensor is to be accurate to within 0.02" w.g. and is to be self-calibrating. Upon a rise in building pressure, the unit controls are to slow down the supply air fan (through the variable speed drive). The opposite is to happen on a drop in building pressure.

M. Electrical:

1. Unit shall be provided with a factory installed and wired main disconnect switch. Integral branch fusing shall be accomplished through the use of resettable circuit breakers. Replaceable fuses are NOT acceptable.

2. Unit shall be provided with phase and brown-out protection to shut down all motors in the unit if the phases are more than 10% out of balance on voltage, or the voltage is more than 10% under design voltage or on phase reversal. In the event that a poor power condition is detected, the power monitoring feature will instantaneously shut the unit down and isolate the microprocessor controller from the incoming power supply. The Power Monitor feature shall record and save a minimum of 10 fault conditions in the fault history log. The Power Monitor feature shall automatically restart the unit after power has returned within acceptable parameters for a preset period of time.
3. Unit shall be provided with a factory installed and wired 115 volt, 12 amp ground fault service receptacle powered by a 1.5 KVA transformer. The convenient outlet shall be fed by an independent power supply.

2.03 MOTORS

- A. Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment" for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
- C. Enclosure Type: Open, dripproof.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roof for compliance with requirements for conditions affecting installation and performance of rooftop units. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install units according to manufacturer's written instructions.
- B. Install units level and plumb, maintaining manufacturer's recommended clearances.
- C. Curb Support: Install roof curbs in such manner as maintain roof bond. Provide roof opening, flashing, counter-flashing, sealant, roof insulation and structural framing members. Install and secure rooftop units on curbs.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 1. Install piping to allow service and maintenance.
 2. Gas Piping: Comply with applicable requirements in Division 22 Section "Natural Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts.

3.04 FIELD QUALITY CONTROL AND COMMISSIONING

- A. Verify that installation is as indicated and specified.
- B. Complete commissioning pre-functional testing and functional testing as part of the following.
- C. Complete manufacturer's installation and startup checks and perform the following:

1. Level unit on curb, and flash curbs to unit and to roof.
 2. Inspect for visible damage to unit casing.
 3. Verify that clearances have been provided for servicing.
 4. Check that labels are clearly visible.
 5. Verify that controls are connected and operable.
 6. Remove shipping bolts, blocks, and tie-down straps.
 7. Verify that filters are installed.
 8. Clean furnace flue and inspect for construction debris.
 9. Connect and purge gas line.
 10. Adjust vibration isolators.
 11. Inspect operation of barometric dampers.
 12. Check operation of mixing dampers.
- D. Lubricate bearings on fan.
- E. Check fan-wheel rotation for correct direction without vibration and binding.
- F. Adjust fan belts to proper alignment and tension.
- G. Start unit according to manufacturer's written instructions.
- H. Check and record performance of interlocks and protection devices; verify sequences.
- I. Operate unit for an initial period as recommended or required by manufacturer.
- J. Check internal isolators.
- K. Check outside-air damper for proper stroke and interlock with return-air dampers.
- L. Check controls for correct sequencing of heating, cooling, mixing dampers, and normal and emergency shutdown.
- M. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency. Adjust pilot to stable flame.
1. Measure gas pressure on manifold.
 2. Measure combustion-air temperature at inlet to combustion chamber.
 3. Measure flue-gas temperature at furnace discharge.
 4. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 5. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
- N. Start refrigeration system and measure and record the following:
1. Coil leaving-air, dry- and wet-bulb temperatures.
 2. Coil entering-air, dry- and wet-bulb temperatures.
 3. Outside-air, dry-bulb temperature.
 4. Outside-air-coil, discharge-air, dry-bulb temperature.

- O. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - 1. Supply-air volume.
 - 2. Outside-air intake volume.
- P. After starting and performance testing, change filters, vacuum heat exchanger and coils, lubricate bearings, and adjust belt tension.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel.
 - 1. Conduct training as specified in Section 01 79 00 "Training".
 - 2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
 - 3. Review data in the maintenance manuals.

END OF SECTION

SECTION 23 74 40 - POOL DEHUMIDIFICATION UNITS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pool Dehumidification Units with Remote Condensing Units

B. Related Sections:

1. Division 21 11 23 – Facility Natural-Gas Piping
2. Section 23 05 00 – Common Work Results for HVAC
3. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
4. Section 23 05 48 – Vibration and Seismic Control for HVAC Piping and Equipment
5. Section 23 05 53 – Identification for HVAC Piping and Equipment
6. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
7. Section 23 09 00 – Instrumentation and Control for HVAC
8. Section 23 09 93 – Sequence of Operation for HVAC Controls
9. Division 26 Sections for electrical connections.

1.02 REFERENCES

A. Air-Conditioning, Heating and Refrigeration Institute (AHRI) Publications:

1. 410 "Forced Circulation Air-Cooling and Air-Heating Coils"

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Publications:

1. 62.1 "Ventilation for Acceptable Indoor Air Quality (ANSI Approved)"
2. 90.1 "Energy Code for Commercial and High-Rise Residential Buildings"

C. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. B117 "Standard Practice for Operating Salt Spray (Fog) Apparatus"

D. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"
2. 90A "Standard for the Installation of Air Conditioning and Ventilating Systems"

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Submit "Letter of Conformance" in accordance with Section 01 33 00 indicating specified items selected for use in project with the following supporting data.

1. Product Data including manufacturer's technical data, clearly indicated for each model, including: rated capacities, operating characteristics, dimensions, weights (shipping, installed, and operating), furnished specialties, accessories, and installation and startup instructions.

2. Shop Drawings from manufacturer detailing equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wiring Diagrams detailing wiring for power, signal, and control systems. Clearly differentiate between manufacturer-installed and field-installed wiring.
4. Maintenance data for energy recovery units to include in the operation and maintenance manual specified in Division 01 and in Section 23 05 00 "Common Work Results for HVAC."

1.04 QUALITY ASSURANCE

- A. ARI Certification: Dehumidification system performance shall be certified to meet ARI Standard 910.
- B. UL and NEMA Compliance: Provide motors required as part of air-handling units that are listed and labeled by UL and comply with applicable NEMA standards.
- C. Comply with NFPA 70 for components and installation.
- D. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
 1. The Terms "Listed" and "Labeled": As defined in the NFPA National Electrical Code, Article 100.
- E. Comply with ASHRAE/IESNA Standard 62.1-2004, Section 7 – "Construction and Startup."

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver rooftop units as factory-assembled units with protective crating and covering.
- B. Coordinate delivery of units in sufficient time to allow movement into building.
- C. Handle rooftop units to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

1.06 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described in Section 01 78 43 "Spare Parts and Materials" that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.08 WARRANTY

- A. General Warranty: The manufacturer shall warrant all equipment for a period of one (1) year from date of substantial completion. Extended warranty 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. Extended Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of rooftop air conditioners that fail in materials or workmanship within specified warranty period.

1. Extended Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Extended Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers:

1. Pool Dehumidification Unit
 - a. Desert Aire

2.02 POOL DEHUMIDIFICATION UNITS

A. Description: DX/gas, pool dehumidification unit with remote condensing unit of capacities and characteristics as scheduled on the drawings.

1. Each unit shall be completely factory assembled, piped, wired, tested and shipped in one piece, with the exception of the interconnecting piping and wiring between the air handler portion and the remote condensing unit.

B. Unit Cabinet:

1. Unit shall be fabricated per the following method:
 - a. Base shall be U.S. 12-gauge galvanneal steel
 - b. Corner posts and side posts shall be formed U.S. 18-gauge galvanneal steel
 - c. Top panels and removable side panels shall be a minimum of U.S. 18-gauge galvanneal steel.
 - d. Removable panels shall be provided to allow easy access to all internal parts and components.
 - e. Electrical control box and switch panel shall be enclosed in a separate compartment, complete with a hinged door.
 - f. Prior to painting, all metal parts shall be pretreated to remove oils and dirt and rinsed with an ionized solution.
 - g. Painting shall be by a powder coat technique to assure positive adherence with a high impact finish.
 - h. All sides of panels shall be painted after manufacturing.
 - i. The paint shall be High Yield Polyester.
 - j. The paint shall be rated to meet a minimum of 1,000-hour salt spray test (ASTM B117), have a minimum Direct impact Resistance of 160 in-lbs (ASTM D2794), have a minimum flexibility of 1/4" Mandrel (ASTM D522, Method B) and a minimum 1000-hour Humidity Resistance (ASTM D2247).
 - k. The unit color shall be Almond.

C. Refrigeration System:

1. Refrigerant shall be R-410a.

2. The compressor shall be a heavy-duty, scroll, hermetic compressor. The compressor shall be equipped with low and high pressure safety switches, with internal protection from overheating. The compressor shall be externally vibration isolated.
3. The unit shall include hot gas bypass for each system compressor set.
4. The unit shall include a refrigerant receiver. The receiver shall assist the unit in operating at the highest efficiency over a wide range of load conditions.
5. Evaporator Dehumidifier Coils:
 - a. Fins shall be die-formed, raised lanced aluminum and be damage resistant. Extruded fin collars provide maximum heat transfer. Fin spacing shall be 12 fins per inch. The coil shall be a maximum of 30" in height.
 - b. Coil shall be fabricated from seamless drawn copper. The inner tubing shall be rifled to produce turbulent refrigeration flow to enhance the heat transfer process. The tubes shall be hydraulically expanded into the fins to form a permanent metal-to-metal bond for maximum heat transfer and stability.
 - c. Coils shall be leak tested with 540 psig of nitrogen.
 - d. Provide a fixed evaporator bypass opening to bypass a portion of the return air stream. After the evaporator has dehumidified its portion of the air stream, the mixing of the bypass and evaporator air shall result in a temperature above the space dew point temperature.
6. Refrigerant Condenser Coils - Air-cooled Condenser (Reheat Coil):
 - a. Fins shall be die-formed, raised lanced aluminum and be damage resistant. Fin spacing shall be 12 fins per inch.
 - b. Coil shall be fabricated from seamless drawn copper. The inner tubing shall be rifled to produce turbulent refrigeration flow to enhance the heat transfer process. The tubes shall be hydraulically expanded into the fins to form a permanent metal-to-metal bond for maximum heat transfer and stability.
 - c. Coils shall be leak tested with 625 psig of nitrogen.
 - d. The reheat coil shall be positioned with a minimum of 5" clearance from the evaporator coil to help prevent water re-evaporation.
7. Provide horizontal discharge with gas heater as scheduled on the drawings.
8. Remote Air-Cooled Condenser:
 - a. The size and capacity shall be in accordance with the unit schedule. The system shall be able to reject all of the recovered heat to the outdoor condenser.
 - b. The unit shall be provided with a weatherproof electrical panel with factory mounted door interrupt disconnect switch.
 - c. The cabinet shall be constructed of heavy-gauge aluminum. The sides shall be one-piece construction. The unit shall be provided with lifting eyes located on the fan discharge panel.
 - d. The coil shall be constructed of copper tubing in a staggered design. Tubes shall be hydraulically expanded into full-collared, plate-type aluminum fins. Coils shall be factory leak-tested and sealed with caps.

- e. The fan motors shall be heavy-duty PSC or three-phase with permanently lubricated ball bearings and built-in overload protection. All motors shall be factory wired with leads terminating in a weatherproof junction box located on the outside of the unit cabinet.
 - f. The fan diameter shall not exceed 30" All units shall have a dynamically balanced fan with aluminum blades and painted steel hubs.
 - g. The fans shall be cycled based on internal head pressure on multiple fan units.
 - h. Fan guards shall be heavy-gauge, closed-mesh steel wire with vinyl coating. Guards shall be contoured for maximum rigidity.
- D. Outdoor air volume shall be as scheduled.
- E. The Condensate Drain Pan shall be 20-gauge stainless steel, sloped and positioned under the dehumidifier coil. The drain pan shall be welded and securely attached to the evaporator endplates to avoid shifting. The drain pan shall be fitted with a minimum 1" MPT non-corrosive plastic drain connection. The drain pan shall meet all the requirements of ASHRAE Standard 62.
- F. Thermal and Sound Insulation shall be 3/4" thick engineered polymer closed-cell foam insulation (EPFI) and shall meet NFPA 255 Flame Spread of 25 and Smoke Developed rating of 50.
- G. Blower:
 - 1. Housing shall be made of galvanized steel and mounted on permanently lubricated, sealed ball bearings.
 - 2. Blower assembly shall be forward curved, centrifugal, and statically and dynamically balanced.
 - 3. Motor shall be ODP or TEFC, Class B insulated, continuous duty, 40°C ambient with three phase overloads.
- H. Return air filter shall be 4" pleated MERV 8 disposable type.
- I. Electrical Control Panel:
 - 1. The electrical control panel shall be easily accessible and shall be of adequate size to house all electrical controls and devices.
 - 2. The unit shall be provided with a single point power connection (one to each piece) to serve controls, fans and compressors, factory wired to the power connection lug set.
 - 3. Electrical controls shall include low voltage transformers to supply 24 VAC control power, clearly labeled high and low voltage terminal strips, high and low pressure control (with manual reset of the high pressure cutout and automatic reset of the low pressure cutout) and an anti-short-cycling timer to protect against compressor cycling.
- J. Control System:
 - 1. A digital control system using a 16 bit microprocessor will be used to accurately and precisely control the dehumidification system and the space environment.
 - 2. The controller will include three (3) levels of password protection.
 - 3. The controller will provide precise system control and feature an easy to read display which indicates actual operating and set point.
 - 4. The display will be remote mountable up to 1640 feet from the unit.

5. The controller will have a built-in occupancy timer.
6. The unit will include a combination wall temperature and humidity sensor to be field installed.
7. The following control points will be available as read/write through the on board terminal:
 - a. Zone Air RH Setpoint
 - b. Zone Air RH Differential
 - c. Zone Air Temperature Setpoint
 - d. Zone Cooling Differential
 - e. Zone Heating Differential
 - f. Energy Recovery Deadband
 - g. Network Occupied Input
 - h. Network Remote ON/OFF command
8. The controller will include the following alarms:
 - a. Low Suction Pressure
 - b. High Discharge Pressure
 - c. Zone Temperature Out of Range
 - d. Blower Motor Overload
 - e. Compressor Overload
 - f. Supply Air Temperature Out of Range
- K. Roof Curb shall be of heavy-gauge galvanized steel construction, of box section design with integral base plate, and shall have continuously welded corner seams. The curb shall be internally insulated with three-pound density rigid fiberglass board insulation not less than 1-1/2" thick. The curb shall be of a design with integral cants and shall be designed to be roofed over. The curb shall include a factory installed wood nailer strip around the top perimeter. The roof curb shall be sized to fit the equipment to be supported, and shall not be less than a height of 16".

2.03 MOTORS

- A. Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment" for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
- C. Enclosure Type: Open, dripproof.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roof for compliance with requirements for conditions affecting installation and performance of rooftop units. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install units according to manufacturer's written instructions.
- B. Install units level and plumb, maintaining manufacturer's recommended clearances.
- C. Curb Support: Install roof curbs in such manner as maintain roof bond. Provide roof opening, flashing, counter-flashing, sealant, roof insulation and structural framing members. Install and secure rooftop units on curbs.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping to allow service and maintenance.
 - 2. Gas Piping: Comply with applicable requirements in Division 22 Section "Natural Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts.

3.04 FIELD QUALITY CONTROL AND COMMISSIONING

- A. Verify that installation is as indicated and specified.
- B. Complete commissioning pre-functional testing and functional testing as part of the following.
- C. Complete manufacturer's installation and startup checks and perform the following:
 - 1. Level unit on curb, and flash curbs to unit and to roof.
 - 2. Inspect for visible damage to unit casing.
 - 3. Verify that clearances have been provided for servicing.
 - 4. Check that labels are clearly visible.
 - 5. Verify that controls are connected and operable.
 - 6. Remove shipping bolts, blocks, and tie-down straps.
 - 7. Verify that filters are installed.
 - 8. Clean furnace flue and inspect for construction debris.
 - 9. Connect and purge gas line.
 - 10. Adjust vibration isolators.
 - 11. Inspect operation of barometric dampers.
 - 12. Check operation of mixing dampers.
- D. Lubricate bearings on fan.
- E. Check fan-wheel rotation for correct direction without vibration and binding.
- F. Adjust fan belts to proper alignment and tension.
- G. Start unit according to manufacturer's written instructions.
- H. Check and record performance of interlocks and protection devices; verify sequences.

- I. Operate unit for an initial period as recommended or required by manufacturer.
- J. Check internal isolators.
- K. Check outside-air damper for proper stroke and interlock with return-air dampers.
- L. Check controls for correct sequencing of heating, cooling, mixing dampers, and normal and emergency shutdown.
- M. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency. Adjust pilot to stable flame.
 - 1. Measure gas pressure on manifold.
 - 2. Measure combustion-air temperature at inlet to combustion chamber.
 - 3. Measure flue-gas temperature at furnace discharge.
 - 4. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - 5. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
- N. Start refrigeration system and measure and record the following:
 - 1. Coil leaving-air, dry- and wet-bulb temperatures.
 - 2. Coil entering-air, dry- and wet-bulb temperatures.
 - 3. Outside-air, dry-bulb temperature.
 - 4. Outside-air-coil, discharge-air, dry-bulb temperature.
- O. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - 1. Supply-air volume.
 - 2. Return-air volume.
 - 3. Relief-air volume.
 - 4. Outside-air intake volume.
- P. After starting and performance testing, change filters, vacuum heat exchanger and coils, lubricate bearings, and adjust belt tension.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel.
 - 1. Conduct training as specified in Section 01 79 00 "Training".
 - 2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
 - 3. Review data in the maintenance manuals.

END OF SECTION

SECTION 23 81 13.11 - PACKAGED TERMINAL AIR-CONDITIONERS, THROUGH-WALL UNITS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Packaged Terminal Air Conditioning Units (PTAC)
 - 2. Controls
- B. Related Sections:
 - 1. Section 07 92 00 - Joint Sealants
 - 2. Section 23 09 00 - HVAC Instrumentation and Controls

1.02 REFERENCES

- A. American Architectural Manufacturers Association (AAMA) Publications:
 - 1. 2604 "Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusion and Panels"
- B. Air-Conditioning, Heating and Refrigeration Institute (AHRI) Publications:
 - 1. 270 "Sound Rating of Outdoor Unitary Equipment"
 - 2. 310/380 "Packaged Terminal Air-Conditioners and Heat Pumps"
 - 3. 390 "Performance Rating of Single Package Vertical Air-Conditioners and Heat Pumps"
- C. American National Standards Institute (ANSI) Publications:
 - 1. ANSI/NFPA 70, "National Electrical Code"
- D. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Publications:
 - 1. 15 "Safety Standard for Refrigeration Systems"
 - 2. 90.1 "Energy Code for Commercial and High-Rise Residential Buildings"
- E. Underwriter's Laboratories, Inc. (UL) Standards:
 - 1. 486A "Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors"
 - 2. 486B "Standard for Wire Connectors for Use With Aluminum Conductors"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Submit "Letter of Conformance" in accordance with Section 01 33 00 indicating specified items selected for use in project with the following supporting data.
 - 1. Product Data:
 - a. Include rated capacities, weights, furnished specialties, and accessories for each model indicated.
 - 2. Shop Drawings: Detail layout and installation of wall penetrations.

- a. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
3. Maintenance Data: For equipment to include in the maintenance manuals specified in Section 01 78 23, "Operation and Maintenance Data."
4. Warranties: Special warranties specified in this Section.

1.04 QUALITY ASSURANCE

- A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- B. Energy Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled by UL and cUL.
 1. The Terms "Listed" and "Labeled": As defined in the ANSI/NFPA 70, "National Electrical Code, Article 100.
 2. Unit shall be rated in accordance with AHRI Standard 390 and certified by UL or ETL.

1.05 COORDINATION

- A. Coordinate layout and installation of units and wall construction where unit penetrates wall or is supported by it.

1.06 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
 1. Full Warranty: After date of substantial completion and start-up, the manufacturer will repair or replace any parts which are defective in material or workmanship.
 - a. Warranty Period
 - 1) Friedrich: Two years
 - 2) LG: One year
 - 3) GE: One year
 - 4) Islandaire: One year
 2. Sealed Refrigeration System: Manufacturers standard extended warranty, but not less than four years after date of Substantial Completion.
 - a. Provide free of charge, on-site repair or replacement of the compressor, condenser, evaporator or connecting tubing if defective in material or workmanship. This shall include system refrigeration charge.

3. Non-Sealed Refrigeration System: Manufacturers standard extended warranty, but not less than five years after date of Substantial Completion.
 - a. Provide free of charge, on-site repair or replacement of any non-sealed system part (motor, solenoid, thermistor, thermostat, relays, switch, capacitor, overload, drain valve, bulb heater, fan, stator) if defective in material or workmanship. The replacement part may be new or a remanufactured part. The limited warranty excludes labor including the cost of diagnostics, removal, and reinstallation necessary to accomplish the repair.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Avendra, LLC Preferred Manufacturers:
 1. Friedrich Air Conditioning Co.
- B. Approved Manufacturers:
 1. LG-PTAC
 2. General Electric Company
 3. Islandaire, Inc.

2.02 PACKAGED TERMINAL AIR CONDITIONING UNITS (PTAC) - HEAT PUMPS

- A. Description: Packaged, self-contained, through-the-wall terminal units with room cabinet, electric refrigeration system, heating, and temperature controls; fully charged with refrigerant.
- B. Cabinet: Provide removable front panel with concealed latches.
 1. Mounting: Wall with wall sleeve.
 2. Finish: Manufacturer's standard color.
 3. Control Knobs: If provided, shall be secured so that they can not be easily removed (anti-theft knobs).
 4. Discharge Grille and Access Door: Provide discharge grille with hinged door in top of cabinet for easy access to controls. Hinged door not required if unit has unit or wall mounted digital controls.
 5. Subbase: Enameled steel with adjustable leveling feet and adjustable end plates.
 6. Wall Sleeves: Insulated, Galvanized steel.
 7. Exterior Grille / Louvers: Extruded architectural aluminum or polymer construction.
 - a. Factory applied baked enamel finish.
 - b. Color: Refer to Exterior Finish Index.
- C. Heat Pump Refrigeration System: Direct-expansion indoor coil with reversing valve, capillary restrictor, hermetically sealed compressor with internal spring isolation, external isolation, permanent-split-capacitor motor, and overload protection. Charge with R-410A. Include the following:
 1. Outdoor coil and fan.
 2. Accumulator.

- D. Preventative Maintenance: Split outdoor fan shroud for easy access to outdoor coil for cleaning and maintenance.
- E. Air System: Forward or backward curved, centrifugal, indoor fans with two speed TEFC permanently lubricated permanent-split-capacitor motor, permanent one or two-piece interchangeable polyurethane washable filters, return air indoor filters and outdoor vent filter with concealed operation located under the front panel to manually open and close the outdoor vent.
 - 1. Curtain Deflector: Manufacturers standard curtain deflector to insure the curtains will not blow into the discharge air stream.
- F. Electric-Resistance Heating Coil: Nickel-chromium wire, electric-resistance heating elements with contactor and high-temperature-limit switch.
- G. Condensate Drain: Slinger Technology used to pick up/disperse condensate to outdoor coil for re-evaporation. In addition, provide auxiliary condensate drain kits for connection to piped condensate drain system to a code approved location..
- H. Outdoor Fan: Propeller type with corrosion resistant finish.
- I. Coils: Aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed.
- J. Electrical Requirements: [265] [230/208] volt, pre-wired UL approved length power cord with one NEMA 6 (208/230 VAC) plug to use with wall receptacle.
- K. Insulated Wall Sleeve:
 - 1. Provide polymer wall sleeve with factory installed insulation.

2.03 CONTROLS

- A. Control Module:
 - 1. Unit Mounted Controls: Unit-mounted adjustable thermostat, off-heat-cool mode switch, and fan cycle/continuous switch.
 - 2. Wall Thermostat Controls: Wall thermostat interface with user selectable hi/low fan speed switch.
 - a. Refer to Section 23 09 00 (15900) – “HVAC Instrumentation and Controls”. Standard Thermostats supplies with PTAC units will not be acceptable.
- B. Low Ambient Lockout Control: Prevents cooling cycle operation below 55 deg F ambient outdoor temperature.

2.04 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Factory test to comply with AHRI 270, "Sound Rating of Outdoor Unitary Equipment."
- B. Unit Performance Ratings: Factory test to comply with AHRI 310/380, "Packaged Terminal Air-Conditioners and Heat Pumps."

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units according to manufacturer's written instructions.
- B. Coordinate installation of wall sleeves in finished wall assembly; seal and weatherproof.

- C. Install accessory Molding trim kit to hide any imperfections in wall around wall sleeve.

3.02 CONNECTIONS

- A. Electrical: Connect units to wiring systems and to ground as indicated and instructed by manufacturer.
- B. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

3.04 COMMISSIONING

- A. After installation, check the following:
 - 1. Unit is level on base and is flashed in exterior wall.
 - 2. Unit casing has no visible damage.
 - 3. Compressor, air-cooled condenser coil, and fans have no visible damage.
 - 4. Set outdoor air vent damper to "open" position.
 - 5. Condenser are clean and free of construction debris.
 - 6. Controls are connected and operable, cycle unit through hi/lo fan and heat/cool operation.
 - 7. Shipping bolts, blocks, and tie-down straps are removed.
 - 8. Return air and outdoor vent air filters are installed and clean.
 - 9. Drain pan and slinger ring are functioning properly.
 - 10. Effectively disable the temperature limiter stops.
- B. Check fan-wheel rotation (evaporator and condenser) for correct direction without vibration and binding.
- C. Start unit according to manufacturer's written instructions.
 - 1. Complete manufacturer's startup checks.
- D. After starting and performance test, clean filters.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel.
 - 1. Conduct training as specified in Section 01 79 00 "Training".
 - 2. Train Owner's maintenance personnel on procedures for starting and stopping troubleshooting, servicing, and maintaining equipment.

END OF SECTION

SECTION 23 81 19 - SELF-CONTAINED AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes packaged, air-cooled air-conditioning units with refrigerant compressors and controls intended for indoor installations.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that equipment and refrigerants comply.
 - 2. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- D. Operation and maintenance data.
- E. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ARI Compliance:
 - 1. Applicable requirements in ARI 210/240.
 - 2. Applicable requirements in ARI 340/360.
 - 3. Applicable requirements in ARI 390.
- C. 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 62.1-2004, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

1.4 WARRANTY

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

1. Warranty Period:

- a. For Compressor: **[One] [Five] <Insert number>** year(s) from date of Substantial Completion.
- b. For Parts: **[One] [Five] <Insert number>** year(s) from date of Substantial Completion.
- c. For Labor: **[One] [Five] <Insert number>** year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**

- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:

1. Bard Manufacturing Company.
2. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
3. Engineered Air.
4. Marshall Engineered Products Co. (MEPCO).
5. McQuay International.
6. Trane Inc.
7. USA Coil & Air.
8. Whalen Company (The).
9. **<Insert manufacturer's name>**.

2.2 PACKAGED UNITS

- A. Description: Factory assembled, wired, and tested; and fully charged with refrigerant and oil.

- B. Configuration: Horizontal, ceiling[-**plenum**] mounted.
- C. Configuration: Vertical, floor mounted; [**vertical**] [**and**] [**horizontal**] discharge.
- D. Configuration: Horizontal, ceiling mounted and vertical, floor mounted; [**vertical**] [**and**] [**horizontal**] discharge.
- E. Disconnect Switch: Factory mounted [**in control panel**] [**on cabinet**].

2.3 CABINET

- A. Frame and Panels: Structural-steel frame with galvanized-steel panels and access doors or panels.
 - 1. Exterior-Surface Finish: Factory painted in color selected by Architect.
 - 2. Interior-Surface Finish: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- B. Insulation: **1-inch- (25-mm-)** thick, glass-fiber duct liner complying with ASTM C 1091 and having a microbial coating on cabinet interior and control panel. **1/2-inch- (13-mm-)** thick liner is acceptable for units smaller than **15 tons (50 kW)**.
- C. Return-Air Opening: Rear, [**open**] [**flange for duct connection**].
- D. Corrosion-Resistant Treatment: Phenolic coating on unit interior and exterior.

2.4 SUPPLY-AIR FAN

- A. Fan Material: Galvanized steel.
- B. Configuration: Double-width, double-inlet, forward-curved centrifugal fan; statically and dynamically balanced. [**Vertical**] [**Horizontal**] discharge with flexible discharge collar.
- C. Drive: [**Belt, with fan mounted on permanently lubricated bearings**] [**Direct, with fan and motor resiliently mounted**].
- D. Fan Sheaves: Variable pitch, dynamically balanced, bored to fit shafts, and keyed for initial startup.
- E. Motor Sheave: Variable and adjustable pitch, dynamically balanced, and selected to achieve specified rpm when set at midposition.
- F. Belt Rating: As recommended by manufacturer or a minimum of one and one-half times nameplate rating of motor.
- G. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Special Motor Features: Premium efficiency, as defined in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. **<Insert unique motor characteristics>.**

H. Outdoor-Air-Intake Accessories:

1. Barometric Outdoor-Air Damper: Adjustable-blade damper allowing induction of up to 25 percent outdoor air when evaporator fan is running.
2. Motorized Outdoor-Air Damper: Motorized, two-position blade damper allowing induction of up to 25 percent outdoor air; with spring-return, low-voltage damper motor.
3. Energy-Recovery Ventilator: Assembly of desiccant-coated, heat-recovery wheels and centrifugal exhaust fans to transfer approximately 67 percent of the difference between the sensible and latent heat of outdoor and exhaust air.
4. Air-Side Economizer: Damper assembly allowing induction of up to 100 percent outdoor air to maintain a selected mixed-air temperature; and exhaust damper and spring-return, low-voltage, modulating damper motor with minimum position adjustment.

2.5 REFRIGERATION SYSTEM

- A. Compressor: Scroll type, hermetically sealed, 3600 rpm maximum, and resiliently mounted with positive lubrication and internal motor protection.
- B. Refrigerant Coils (Indoor and Outdoor for Air-Cooled Units): Seamless copper tubes expanded into aluminum fins.
1. Corrosion-Resistant Treatment: Phenolic coating applied with multiple dips and baked.
 2. Refrigerant Circuits: A separate circuit for each compressor, with externally equalized thermal-expansion valve, filter dryer, and charging valves.
 3. Mount coil assembly over stainless-steel drain pan[**complying with ASHRAE 62.1-2004**] [and] [**having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir**].
 4. Refrigerant: [**R-22**,]R-407C or R-410A.
 5. Expansion valve with replaceable thermostatic element.
 6. Refrigerant dryer.
 7. High-pressure switch.
 8. Low-pressure switch.
 9. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
 10. Low ambient temperature switch.
 11. Brass service valves installed in discharge and liquid lines.

2.6 HEATING COIL

- A. 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.

2.7 CONTROLS

- A. Control Package: Factory wired, including contactor, high- and low-pressure cutouts, internal-winding thermostat for compressor, control-circuit transformer, and noncycling reset relay.
- B. Time-Delay Relay: Five-minute delay to prevent compressor cycling.
- C. Adjustable Thermostat: [**Unit mounted**] [**Remote**] to control the following:
 - 1. Supply fan.
 - 2. Compressor.
 - 3. Condenser.
 - 4. Electric heater.
- D. System Selector Switch: [**Heat-off-cool**] [**Off-heat-auto-cool**].
- E. Fan Control Switch: Auto-on.
- F. Microprocessor Control Panel: Controls unit functions as standalone or network operation, including refrigeration and safety controls, with unit-mounted display, and the following:
 - 1. Supply fan.
 - 2. Supply-fan motor speed.
 - 3. Compressors.
 - 4. Air-cooled condenser.
 - 5. Multistep, electric heater.
 - 6. Time-of-day control to cycle unit on and off.
 - 7. Night-heat, morning warm-up cycle.
 - 8. Economizer control.
 - 9. Panel-mounted control switch to operate unit in remote or local control mode or to stop or reset.
 - 10. Panel-mounted indication of the following:
 - a. Operating status.
 - b. System diagnostics and safety alarms.
 - c. Supply-air temperature set point.
 - d. Zone heating-temperature set point.
 - e. Supply-air pressure set point.
 - f. Economizer minimum position set point.
 - g. Supply-air-pressure, high-limit set point.
 - h. Monitor motor loads.
 - i. Monitor economizer cycle.
 - j. Monitor cooling load.
 - k. Monitor air distribution static pressure and ventilation air volumes.

2.8 CAPACITIES AND CHARACTERISTICS

- A. Cooling Capacity:
 - 1. Total: <Insert **Btu/h (kW)**>.

2. Sensible: **<Insert Btu/h (kW)>**.
 3. Seasonal Energy Efficiency Ratio: **[10.0] [12.0] [13.0] [14.0] [16.0] <Insert ratio>**.
 4. Energy Efficiency Ratio: **[10.0] [12.0] [13.0] [14.0] [16.0] <Insert ratio>**.
 5. Moisture Removal Rate: **<Insert pints/h (L/h)>**.
 6. Entering-Air Temperature:
 - a. Dry Bulb: **<Insert deg F (deg C)>**.
 - b. Wet Bulb: **<Insert deg F (deg C)>**.
 7. Leaving-Air Temperature:
 - a. Dry Bulb: **<Insert deg F (deg C)>**.
 - b. Wet Bulb: **<Insert deg F (deg C)>**.
- B. Heating Capacity:
1. Total: **<Insert Btu/h (kW)>**.
 2. Air-Temperature Rise: **<Insert deg F (deg C)>**.
 3. Heat Pump:
 - a. Coefficient of Performance: **<Insert value>**.
 - b. Heating Season Performance Factor: **[7.7] [8.0] <Insert value>**.
 4. Electric Heat:
 - a. Total Capacity: **<Insert Btu/h (kW)>**.
 - b. Air-Temperature Rise: **<Insert deg F (deg C)>**.
 - c. Control Steps: **[One] [Two] [Three] <Insert number>**.
- C. Auxiliary Electric Heat:
1. Total Capacity: **<Insert Btu/h (kW)>**.
 2. Air-Temperature Rise: **<Insert deg F (deg C)>**.
 3. Control Steps: **[One] [Two] [Three] <Insert number>**.
- D. Supply-Air Fan:
1. Fan motor.
 2. Size: **<Insert value> hp**.
 3. **[Multispeed, PSC] [Open-dripproof] [Totally enclosed fan-cooled]** type.
 4. Total Airflow:
 - a. High: **<Insert cfm (L/s)>**.
 - b. Low: **<Insert cfm (L/s)>**.
 5. Outdoor Airflow: **<Insert cfm (L/s)>**.
- E. Air-Cooled Condenser:
1. Fan Quantity: **[Two] [Four] <Insert number>**.
 2. Motor Speed: **<Insert value> rpm**.

3. Motor Horsepower: **<Insert value>**.

F. Filters:

1. Prefilters:

- a. Type: **[Flat] [Pleated]** disposable panel.
- b. MERV: **<Insert number>**.
- c. Face Area: **<Insert sq. ft. (sq. m)>**.
- d. Surface Area: **<Insert sq. ft. (sq. m)>**.
- e. Thickness or Depth: **[2 inches (50 mm)] [4 inches (100 mm)]**.
- f. Number of Filters: **<Insert number>**.
- g. Maximum or Rated Face Velocity: **<Insert fpm (m/s)>**.
- h. Initial Resistance: **<Insert inches wg (Pa)>**.
- i. Recommended Final Resistance: **<Insert inches wg (Pa)>**.
- j. Access Location: **[Front] [Back] [Side]**.

2. Final Filter:

- a. Type: **[Flat] [Pleated]** disposable panel.
- b. MERV: **<Insert number>**.
- c. Face Area: **<Insert sq. ft. (sq. m)>**.
- d. Surface Area: **<Insert sq. ft. (sq. m)>**.
- e. Thickness or Depth: **[2 inches (50 mm)] [4 inches (100 mm)]**.
- f. Number of Filters: **<Insert number>**.
- g. Maximum or Rated Face Velocity: **<Insert fpm (m/s)>**.
- h. Initial Resistance: **<Insert inches wg (Pa)>**.
- i. Recommended Final Resistance: **<Insert inches wg (Pa)>**.
- j. Access Location: **[Front] [Back] [Side]**.

G. Accessories:

1. Manual outdoor-air damper.
2. Motorized outdoor-air damper.
3. Air-side economizer.
4. Hot-gas bypass.

H. Single-Point Electrical Characteristics:

1. Volts: **[120] [208] [230] [460] <Insert value>**.
2. Phase: **[Single] [Three]**.
3. Hertz: 60.
4. Full-Load Amperes: **<Insert value>**.
5. Minimum Circuit Ampacity: **<Insert value>**.
6. Maximum Overcurrent Protection: **<Insert amperage>**.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Anchor units to structure.
- C. Install seismic restraints.
- D. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply[**and return**] ducts to self-contained air conditioners with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."

3.2 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. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation, and inspect for refrigerant leaks.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Units will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 238119

SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit EA 4: For refrigerants, documentation including printed statement that refrigerants are free of HCFCs.
 - 2. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."
- C. 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.
- D. Operation and maintenance data.
- E. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. Applicable requirements in ASHRAE 62.1-2004, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-Up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

1.4 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:
- For Compressor: **[One] [Five] <Insert number>** year(s) from date of Substantial Completion.
 - For Parts: **[One] [Five] <Insert number>** year(s) from date of Substantial Completion.
 - For Labor: **[One] [Five] <Insert number>** year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
- Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
 - Coleman Company Inc. (The).
 - First Operations LP.
 - Friedrich Air Conditioning Company.
 - Koldwave, Inc.; a Mestek company.
 - Lennox International Inc.
 - Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
 - Mitsubishi Electric Sales Canada Inc.
 - Mitsubishi Heavy Industries America, Inc.
 - SANYO North America Corporation; SANYO Fisher Company.
 - Trane; a business of American Standard companies.
 - YORK; a Johnson Controls company.
 - <Insert manufacturer's name>**.

2.2 INDOOR UNITS **5 TONS (18 kW)** OR LESS

- A. Concealed Evaporator-Fan Components:
- Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
 - Insulation: Faced, glass-fiber duct liner.

3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
4. 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.
5. 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.
6. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
7. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
9. Filters: Permanent, cleanable.
10. Condensate Drain Pans:
 - a. Fabricated with **[one] [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.
 - 1) Length: Extend drain pan downstream from leaving face **[to comply with ASHRAE 62.1-2004] <Insert distance>**.
 - 2) Depth: A minimum of **[2 inches (50 mm)] <Insert depth>** deep.
 - b. Single-wall, **[galvanized] [stainless]**-steel sheet.
 - c. Double-wall, **[galvanized] [stainless]**-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
 - d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on **[one end] [both ends]** of pan.
 - 1) Minimum Connection Size: **[NPS 1 (DN 25)] [NPS 2 (DN 50)] <Insert size>**.
 - e. Pan-Top Surface Coating: Asphaltic waterproofing compound.
 - f. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

B. Floor-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.

- a. Discharge Grille: **[Steel with surface-mounted frame] [Welded steel bars forming a linear grille and welded into supporting panel].**
 - b. Insulation: Faced, glass-fiber duct liner.
 - c. Drain Pans: Galvanized steel, with connection for drain; insulated.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. 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.
4. 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.
5. Fan: Direct drive, centrifugal, **[with power-induced outside air]**.
6. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
7. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
 - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
 - b. Disposable Panel Filters:
 - 1) Factory-fabricated, viscous-coated, flat-panel type.
 - 2) Thickness: **[1 inch (25 mm)] [2 inches (50 mm)]**.
 - 3) Dust-Holding Capacity: **<Insert lb (kg)>**.
 - 4) Initial Resistance: **<Insert inches wg (Pa)>**.
 - 5) Recommended Final Resistance: **<Insert inches wg (Pa)>**.
 - 6) Arrestance according to ASHRAE 52.1: **[80] <Insert value>**.
 - 7) Merv according to ASHRAE 52.2: **[5] <Insert value>**.
 - 8) Media: Interlaced glass fibers sprayed with nonflammable adhesive[**and antimicrobial agent**].
 - 9) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.
 - c. Extended-Surface, Disposable Panel Filters:
 - 1) Factory-fabricated, dry, extended-surface type.

- 2) Thickness: [**1 inch (25 mm)**] [**2 inches (50 mm)**] [**4 inches (100 mm)**].
- 3) Dust-Holding Capacity: **<Insert lb (kg)>**.
- 4) Initial Resistance: **<Insert inches wg (Pa)>**.
- 5) Recommended Final Resistance: **<Insert inches wg (Pa)>**.
- 6) Arrestance according to ASHRAE 52.1: [**90**] **<Insert value>**.
- 7) Merv according to ASHRAE 52.2: [**7**] **<Insert value>**.
- 8) Media: Fibrous material formed into deep-V-shaped pleats[**with antimicrobial agent**] and held by self-supporting wire grid.
- 9) Media-Grid Frame: [**Nonflammable cardboard**] [**Galvanized steel**] [**Fire-retardant, 3/4-inch (20-mm) particleboard with gaskets**].
- 10) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

C. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. 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.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Enclosure Type: Totally enclosed, fan cooled.
 - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
 - f. Mount unit-mounted disconnect switches on [**exterior**] [**interior**] of unit.
 - g. **<Insert unique motor characteristics>**.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
7. Condensate Drain Pans:
 - a. Fabricated with [**one**] [**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.
 - 1) Length: Extend drain pan downstream from leaving face [**to comply with ASHRAE 62.1-2004**] **<Insert distance>**.
 - 2) Depth: A minimum of [**1 inch (25 mm)**] **<Insert depth>** deep.
 - b. Single-wall, [**galvanized**] [**stainless**]-steel sheet.

- c. Double-wall, [**galvanized**] [**stainless**]-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
 - d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on [**one end**] [**both ends**] of pan.
 - 1) Minimum Connection Size: [**NPS 1 (DN 25)**] [**NPS 2 (DN 50)**] <Insert size>.
 - e. Pan-Top Surface Coating: Asphaltic waterproofing compound.
8. Air Filtration Section:
- a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
 - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
 - b. Disposable Panel Filters:
 - 1) Factory-fabricated, viscous-coated, flat-panel type.
 - 2) Thickness: [**1 inch (25 mm)**] [**2 inches (50 mm)**].
 - 3) Dust-Holding Capacity: <Insert lb (kg)>.
 - 4) Initial Resistance: <Insert inches wg (Pa)>.
 - 5) Recommended Final Resistance: <Insert inches wg (Pa)>.
 - 6) Arrestance according to ASHRAE 52.1: [**80**] <Insert value>.
 - 7) Merv according to ASHRAE 52.2: [**5**] <Insert value>.
 - 8) Media: Interlaced glass fibers sprayed with nonflammable adhesive[**and antimicrobial agent**].
 - 9) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.
 - c. Extended-Surface, Disposable Panel Filters:
 - 1) Factory-fabricated, dry, extended-surface type.
 - 2) Thickness: [**1 inch (25 mm)**] [**2 inches (50 mm)**] [**4 inches (100 mm)**].
 - 3) Dust-Holding Capacity: <Insert lb (kg)>.
 - 4) Initial Resistance: <Insert inches wg (Pa)>.
 - 5) Recommended Final Resistance: <Insert inches wg (Pa)>.
 - 6) Arrestance according to ASHRAE 52.1: [**90**] <Insert value>.
 - 7) Merv according to ASHRAE 52.2: [**7**] <Insert value>.
 - 8) Media: Fibrous material formed into deep-V-shaped pleats[**with antimicrobial agent**] and held by self-supporting wire grid.
 - 9) Media-Grid Frame: [**Nonflammable cardboard**] [**Galvanized steel**] [**Fire-retardant, 3/4-inch (20-mm) particleboard with gaskets**].
 - 10) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.3 OUTDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. 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.
2. 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.
 - a. Compressor Type: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: [R-22] [R-407C] [R-410A] <Insert type>.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."
- B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
 1. Compressor time delay.
 2. 24-hour time control of system stop and start.
 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 4. Fan-speed selection including auto setting.
- D. Automatic-reset timer to prevent rapid cycling of compressor.
- E. 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.
- F. Drain Hose: For condensate.
- G. Additional Monitoring:
 1. Monitor constant and variable motor loads.

2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

2.5 CAPACITIES AND CHARACTERISTICS

A. Cooling Capacity:

1. Total: <Insert value> Btu/h (kW).
2. Sensible: <Insert value> Btu/h (kW).
3. SEER: [10.0] [12.0] [13.0] [14.0] [16.0] <Insert ratio>.
4. EER: [10.0] [12.0] [13.0] [14.0] [16.0] <Insert ratio>.
5. Moisture Removal: <Insert pints/h (L/h)>.
6. Entering-Air Temperature:
 - a. Dry Bulb: <Insert deg F (deg C)>.
 - b. Wet Bulb: <Insert deg F (deg C)>.
7. Leaving-Air Temperature:
 - a. Dry Bulb: <Insert deg F (deg C)>.
 - b. Wet Bulb: <Insert deg F (deg C)>.

B. Heating Capacity:

1. Type: [Electric] [Natural gas].
2. Total Capacity: <Insert value> Btu/h (kW).
3. Air-Temperature Rise: <Insert deg F (deg C)>.
4. Coefficient of Performance: <Insert value>.
5. Heating Season Performance Factor: [7.7] [8.0] <Insert value>.
6. Hot Water:
 - a. Entering-Water Temperature: <Insert deg F (deg C)>.
 - b. Leaving-Water Temperature: <Insert deg F (deg C)>.
 - c. Water Flow: <Insert gpm (L/s)>.
 - d. Water Pressure Drop: <Insert feet of head (kPa)>.
7. Electric Heating Coil:
 - a. Total Capacity: <Insert value> kW.
 - b. Volts: [120] [208] [230] [460] <Insert value>.
 - c. Phase: [Single] [Poly].
 - d. Hertz: 60.
 - e. Steps: [One] [Two] [Three] <Insert number>.
8. Gas Heating Section:
 - a. Input: <Insert cfh (mL/s)>.
 - b. Output: <Insert cfh (mL/s)>.

C. Auxiliary Heating Capacity:

1. Type: [**Electric**] [**Natural gas**] [**Propane**].
2. Total Capacity: <Insert value> **Btu/h** (**kW**).
3. Volts: [**120**] [**208**] [**230**] [**460**] <Insert value>.
4. Phase: [**Single**] [**Poly**].
5. Hertz: 60.
6. Steps: [**One**] [**Two**] [**Three**] <Insert number>.
7. Input: <Insert **cfh** (**mL/s**)>.
8. Output: <Insert **cfh** (**mL/s**)>.

D. Indoor Unit:

1. Fan Motor Electrical Characteristics:
 - a. Volts: [**120**] [**208**] [**230**] [**460**] <Insert value>.
 - b. Phase: [**Single**] [**Poly**].
 - c. Hertz: 60.
2. Airflow: <Insert value> **cfm** (**L/s**).

E. Outdoor Unit:

1. Type: [**Air cooled**] [**Water cooled**].
2. Electrical Characteristics:
 - a. Volts: [**120**] [**208**] [**230**] [**460**] <Insert value>.
 - b. Phase: [**Single**] [**Poly**].
 - c. Hertz: 60.
 - d. Minimum Circuit Ampacity: <Insert value>.
 - e. Maximum Overcurrent Protection: <Insert amperage>.
 - f. Fan Motor Full-Load Amperes: <Insert value>.
 - g. Compressor Full-Load Amperes: <Insert value>.
 - h. Compressor Locked-Rotor Amperes: <Insert value>.
3. Sound-Pressure Level: <Insert value> dBa.
4. Water:
 - a. Entering-Water Temperature: <Insert **deg F** (**deg C**)>.
 - b. Water Flow: <Insert **gpm** (**L/s**)>.
 - c. Water Pressure Drop: <Insert **feet of head** (**kPa**)>.

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 ground-mounted, compressor-condenser components on ~~4-inch-~~ (100-mm-) thick, reinforced concrete base that is ~~4 inches~~ (100 mm) larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.
- D. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
- E. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- F. Install seismic restraints.
- G. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of [~~1 inch~~ (25 mm)] **<Insert static deflection>**. See Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- H. 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 Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Water Coil Connections: Comply with requirements specified in Division 23 Section "Hydronic Piping." 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.
 - 2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Division 23 Section "Hydronic Piping." Connect hydronic piping to supply and return 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 Division 23 Section "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 Division 23 Section "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. **[Engage a factory-authorized service representative to train] [Train]** Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 23 82 39 - UNIT HEATERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Electric Wall Heaters
 - 2. Unit Heaters.
 - 3. Cabinet Unit Heaters.
 - 4. Duct Heaters.
 - 5. Baseboard Heaters.
- B. Related Sections:
 - 1. Section 23 05 00 – Common Work Results for HVAC
 - 2. Division 26 Sections for electrical connections.

1.02 REFERENCES

- A. National Fire Protection Association (NFPA) Publications:
 - 1. 70 "National Electric Code"
 - 2. 90A "Standard for the Installation of Air Conditioning and Ventilating Systems"
- B. Underwriter's Laboratories, Inc. (UL) Standards:
 - 1. 486A "Standard For Wire Connectors and Soldering Lugs for Use With Copper Conductors"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Submit "Letter of Conformance" in accordance with Section 01 33 00 indicating specified items selected for use in project with the following supporting data.
 - 1. Product data for each type of product specified.
 - 2. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.
 - 3. Samples of cabinet finish colors for approval.
 - 4. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Owner's Representatives and owners, and other information specified.
 - 5. Field test reports from a qualified independent inspecting and testing agency indicating and interpreting test results relative to compliance with performance requirements of unit heaters.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firm experienced in manufacturing unit heaters similar to those indicated for this Project and that have a record of successful in-service performance.

- B. Comply with NFPA 70 for components and installation.
- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Indeeco
 - 2. Emerson Electric Co.
 - 3. QMark
 - 4. Markel Products Company

2.02 ELECTRICAL UNIT HEATERS

- A. Heating Elements: Nickel-chromium heating wire element; free from expansion noise and 60-Hz hum; embedded in magnesium oxide, insulating refractory; and sealed in high-mass steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends are enclosed in terminal box. Fin surface temperature does not exceed 550 deg F at any point during normal operation.
- B. Heater Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for overtemperature protection of heaters.
- C. Fan and Motor: Direct-drive propeller fan and manufacturer's standard motor. Motors sized 1 hp and less include motor overload protection.
- D. Wiring Terminations: Match conductor materials and sizes indicated.
- E. Discharge Configuration: Horizontal discharge with horizontal, adjustable louvers.
- F. Optional Accessories: Include the following:
 - 1. Wall thermostat.
 - 2. Safety-switch disconnect on cover of terminal box.
 - 3. Mercury contactors.
 - 4. Fan-delay relay.

2.03 ELECTRICAL CABINET UNIT HEATERS

- A. Description:
 - 1. Surface-mounted cabinet with front grille air inlet and front air outlet.
 - 2. Surface-mounted cabinet with front grille air inlet and top air outlet.
 - 3. Surface-mounted cabinet with bottom air inlet and front air outlet.
 - 4. Surface-mounted cabinet with bottom air inlet and top air outlet.
 - 5. Semi-recessed, wall-mounted cabinet with front grille air inlet and front air outlet.
 - 6. Semi-recessed, ceiling-mounted cabinet.

- B. Heating Elements: Nickel-chromium heating wire element; free from expansion noise and 60-Hz hum; embedded in magnesium oxide, insulating refractory; and sealed in high-mass steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch (4 mm). Element ends are enclosed in terminal box. Fin surface temperature does not exceed 550 deg F (288 deg C) at any point during normal operation.
- C. Heater Circuit Protection: One-time fuses in terminal box for over-current protection and limit controls for over-temperature protection of heaters.
- D. Fan and Motor: Centrifugal blower, direct driven by a single-phase, 2-speed electric motor with inherent overload protection and resilient motor/fan mount.
- E. Wiring Terminations: Match conductor materials and sizes indicated.
- F. Unit Controls: Thermostat, fan-speed switch, fan ON-AUTOMATIC switch, interval timer, and outside air-damper control switch.
- G. Optional Accessories: Include the following:
 - 1. Integral thermostat.
 - 2. Disconnect switch.
 - 3. Mercury contactor.
 - 4. Fan-delay relay.
 - 5. Kickplate base for floor-mounted units.
- H. Finish cabinet with manufacturer's standard enamel, color as selected by Owner's Representative.

2.04 ELECTRIC WALL HEATERS:

- A. General: Provide electric wall heaters with architectural styling for exposed or recessed application.
- B. Heater Assembly: The heater assembly which fits into the back box shall consist of a fan panel upon which is mounted all of the operational parts of the heater.
- C. Heating Element: The heating elements shall be of the non-glowing design consisting of a special resistance wire enclosed in a steel sheath to which steel plate fins are copper brazed. It shall be warranted for 5 years.
- D. Fan and Motor: Fan shall be five bladed aluminum. Fan motor shall be totally enclosed.
- E. Fan Delay Switch: Fan control shall be of bi-metallic, snap-action type and shall activate fan after heating element reaches operating temperature. The fan shall continue to operate after the thermostat is satisfied and until the heating element is cool.
- F. Thermostat: The tamper-proof thermostat shall be of the bimetallic snap-action type with enclosed contacts. It shall be completely concealed and reactive behind the front cover to become tamper proof.
- G. Thermal Cutout: A thermal cutout shall be built into the system to automatically shut off the heater in the event of overheating and reactivate the heater when temperatures return to normal.
- H. Disconnect Switch: A double-pole, single throw disconnect switch shall be mounted on the back box for positive disconnect of power supply. It will be completely concealed behind the front grid panel.

- I. Back Box: The back box shall be designed for duty as a recessed rough-in box in either masonry or frame installations, and is also used with the surface mounting box in surface mounted installations. The back box shall be 20 gage cold-rolled steel and shall contain knockouts through which power leads are brought.
- J. Front Panel: The front panel shall be of the bar grille type and shall be constructed of 16 gage cold-rolled steel, welded into a uniform grille to direct the warmed air toward the floor. The front grille shall be surrounded by a decorative satin-finish aluminum "picture" frame.
- K. Three Piece Design: The heater shall be made up of a back box, a heater assembly and a front panel.

2.05 ELECTRIC DUCT HEATERS

- A. Furnish electric duct heaters of the size, capacity, and mounting style indicated on plans. Heaters shall be UL listed for zero clearance and shall meet all applicable requirements of the National Electrical Code.
- B. Elements: Construct of 80% nickel and 20% chromium; steps shall be arranged to prevent stratification when operating at less than full capacity.
- C. Coil Terminals: Stainless steel, terminal insulators, and bracket bushings shall be constructed of ceramic and securely positioned. Terminals shall be machine crimped to coil.
- D. Frame: Construct of heavy gauge galvanized steel to assure structural rigidity and vertical galvanized steel supports with stiffening ribs and gussets.
- E. Terminal Box: Provide with solid cover and hinge if built-in fuses or interlocking disconnect switches are provided. Heater terminal box must be totally enclosed. Provide access panel on both sides of heater.
- F. Controls: Include automatic reset thermal cutout, differential pressure air flow switch, and fan interlock relays. All safety devices shall be serviceable through the terminal box without removing the heating coil from the duct. Provide multiple stages of control as indicated on the drawings.
- G. Wiring: Power circuits shall have single point termination to built-in disconnect switch. Each sub-circuit shall be fused per N.E.C. and a fuse control circuit transformer shall be provided.

2.06 ELECTRIC BASEBOARD HEATERS

- A. Electric baseboard heaters shall be commercial grade having capacity as indicated.
- B. Heating elements shall have aluminum fins bonded to steel sheathed electric heating elements.
- C. Heater enclosures shall have baked enamel finish and bar-type grilles.
- D. Heater shall have integral thermostat.
- E. Heater shall be UL listed and shall meet the requirements of the National Electrical Code.
- F. Baseboard heater shall be color as selected by Owner's Representative or prime painted ready for final field painters to match adjacent surface.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and supports to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install heaters as indicated, according to manufacturer's written instructions and NFPA 90A.
- B. Connect heaters and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

3.03 FIELD QUALITY CONTROL

- A. Testing: After installing unit heaters and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
- B. Remove and replace malfunctioning units with new units and retest.

3.04 CLEANING

- A. Replace filters in each cabinet unit heater at project closeout.

END OF SECTION

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Supporting Devices For Electrical Components.
2. Electricity-Metering Components.
3. Concrete Equipment Bases.
4. Electrical Demolition.
5. Cutting And Patching For Electrical Construction.
6. Touchup Painting.

B. Related Sections:

1. Section 03 30 00 (03300) - Cast-In-Place Concrete.
2. Section 07 84 00 (07840) - Firestopping.
3. Section 09 90 00 (09900) - Painting.

1.02 REFERENCES

A. American Welding Society (AWS) Publications:

1. D1.1 "Structural Welding Code - Steel"

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

1. A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

D. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. All work to be in accordance with latest requirements of the N.E.C. and all other applicable codes and regulations of authorities having jurisdiction over the work.

1.05 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
 - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 08 Section 08 31 00 - "Access Doors."
- E. Coordinate all work with Division 26. Electrical Contractor shall provide all wiring and final connection to all line voltage thermostats. Thermostat provided and installed by Division 15.
- F. All electrical drawings are to be read in conjunction with the project specifications and all other related contract drawings.
- G. The contractor shall examine the site and observe the conditions under which the work will be done or other circumstances which will affect the contemplated work. No allowance will be made subsequently in the connection for any error or negligence on the contractor's part.
- H. The contractor shall verify exact location, size and extent of all existing utilities, obstructions and/or other conditions which may affect the proposed work under the project. The contractor shall take every precaution to prevent damage to existing work and shall repair any damage as a result of this work.
- I. The contractor shall verify all door swings in the field and mount switches on knob side of doors or as approved by the engineer.
- J. The contractor shall carefully examine all contract drawings/specifications and be responsible for the proper fittings of materials and equipment at each location as indicated without substantial alteration. The drawings are generally diagrammatic and because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Furnishing such fittings that are required to meet such conditions shall be furnished and installed at no cost.

PART 2 PRODUCTS

2.01 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch diameter slotted holes at a maximum of 2 inches o.c., in webs.
 - 1. Channel Thickness: Selected to suit structural loading.
 - 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- E. Pipe Sleeves: ASTM A53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

- F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
 - G. Expansion Anchors: Carbon-steel wedge or sleeve type.
 - H. Toggle Bolts: All-steel springhead type.
- 2.02 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING
- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
 - B. Meter Sockets: Comply with requirements of electrical power utility company.
- 2.03 CONCRETE BASES
- A. Concrete Forms and Reinforcement Materials: As specified in Section 03 30 00 - "Cast-in-Place Concrete."
- 2.04 TOUCHUP PAINT
- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
 - B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 EXECUTION

3.01 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.
- E. Coordinate work with other trades and install conduit and boxes to clear embedded ducts, openings, etc. and all structural features.
- F. Unless otherwise noted, mounting heights, as shown, are from finished floor to top of panelboard and to centerline of other equipment. Coordinate all mounting heights with contract drawings, local code requirements, and all ADA. requirements.
 - 1. Toggle (snap) switch: 4'-0".
 - 2. Enclosed circuit breaker: 5'-0"
 - 3. Disconnect (safety) switch: 5'-0".
 - 4. Motor starter: 5'-0".
 - 5. Panelboard: 6'-6".

3.02 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations, Pool Equipment Rooms, Storage Rooms and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.03 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw-type nails.
 - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 3. New Concrete: Concrete inserts with machine screws and bolts.
 - 4. Existing Concrete: Expansion bolts.
 - 5. Steel: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1.
 - 6. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
 - 7. Light Steel: Sheet-metal screws.
 - 8. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.04 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.05 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Section 07 84 00 "Firestopping."

3.06 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi 28-day compressive-strength concrete and reinforcement as specified in Section 03 30 00 "Cast-in-Place Concrete."

3.07 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- D. Remove demolished material from Project site.
- E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.08 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.09 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 - 1. Supporting devices for electrical components.
 - 2. Electricity-metering components.
 - 3. Concrete bases.
 - 4. Electrical demolition.
 - 5. Cutting and patching for electrical construction.
 - 6. Touchup painting.

3.10 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Section 09 90 00 (09900) - "Painting."

3.11 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.
- B. Related Documents:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- C. Related Sections:
 - 1. Section 07 84 00 - Firestopping
 - 2. Section 26 05 00– Common Work Results for Electrical
 - 3. Section 26 05 53– Identification for the Electrical Systems

1.02 REFERENCES

- A. National Electrical Contractors Association (NECA) Publications.
- B. National Electrical Manufacturer's Association (NEMA) Standards Publications:
 - 1. WC 26 "Binational Wire and Cable Packaging Standard"
 - 2. WC 70 "Power Cables Rated 2,000 V or Less for the Distribution of Electrical Energy"
- C. InteNational Electrical Testing Association (NETA) Publications:
 - 1. ATS "Standard for Acceptance Testing Specifications"
- D. National Fire Protection Association (NFPA) Publications:
 - 1. 70 "National Electric Code"
- E. Occupational Safety & Health Administration (OSHA) Regulations:
 - 1. 1910.7 "Definition And Requirements For A Nationally Recognized Testing Laboratory"
- F. Underwriter's Laboratories, Inc. (UL) Standards:
 - 1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
 - 2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"

1.03 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 indicating specified items selected for use in Project with the following supporting data:
 - 1. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.04 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

- B. Comply with NFPA 70.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wires and cables according to NEMA WC 26.

1.06 COORDINATION

- A. Coordinate layout and installation of cables with other installations.
- B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Owner representative.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Avendra, LLC Preferred Manufacturers:
 1. Wires and Cables:
 - a. None.
 2. Connectors for Wires and Cables:
 - a. None.
- B. Approved Manufacturers:
 1. Wires and Cables:
 - a. American Insulated Wire Corp.; Leviton Manufacturing Co.
 - b. General Cable.
 - c. Southwire Company
 - d. Alcan Cable Division of Alcan Aluminum Corporation
 2. Connectors for Wires and Cables:
 - a. AMP Incorporated
 - b. O-Z/Gedney Unit
 - c. Square D Co.; a Division of Groupe Schneider
 - d. Alcan Cable Division of Alcan Aluminum Corporation

2.02 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
- B. Rubber Insulation Material: Comply with NEMA WC 70.
- C. Thermoplastic Insulation Material: Comply with NEMA WC 70.
- D. Cross-Linked Polyethylene Insulation Material: Comply with NEMA WC 70.
- E. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 70.
- F. Conductor Material: Copper

1. Feeders 1/0 ampere or greater may be aluminum "Alcan Stabiloy #8000", or approved substitution by listed manufacturers.
- G. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.
- H. Multiconductor Cable: Metal-clad cable, Type MCI.

2.03 CONNECTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 WIRE AND INSULATION APPLICATIONS

- A. Service Entrance: Type RHW or THWN, in raceway.
- B. Horizontal Feeders: Type THHN/THWN, in raceway.
- C. Vertical Feeders: Type THHN/THWN in raceway or type MC cable.
- D. Fire-Pump Feeder: Type MI, 3-conductor.
- E. Horizontal Branch Circuits: Type THHN/THWN, in raceway.
- F. Vertical Branch Circuits: Type THNN/THWW in raceway or Type MC Cable
- G. Fire Alarm Circuits: Type THHN/THWN, in raceway.
- H. Class 1 Control Circuits: Type THHN/THWN, in raceway.
- I. Class 2 Control Circuits: Power-limited cable, concealed in building finishes.
- J. Class 2 Control Circuits: Type THHN/THWN, in raceway.

3.03 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's appropriate "Standard of Installation."
- B. Pull Conductors: 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Section 26 05 00 - "Common Work Results for Electrical."
- F. Seal around cables penetrating fire-rated elements according to Section 07 84 00 "Firestopping."

- G. Identify wires and cables according to Section 26 05 53 "Identification for Electrical Systems."

3.04 CONNECTIONS

- A. Conductor Splices: Keep to minimum.
- B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- C. Use splice and tap connectors compatible with conductor material.
- D. Use oxide inhibitor in each splice and tap connector for aluminum conductors.
- E. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.
- F. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- G. 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 and UL 486B.

3.05 FIELD QUALITY CONTROL

- A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Grounding of Electrical Systems and Equipment.
 - a. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Related Sections:

1. Section 26 05 19– Low Voltage Electrical Power Conductors and Cables.
2. Section 26 41 13 - Lightning Protection for Structures: For additional grounding and bonding materials.
3. Section 32 90 00 - Planting.

1.02 REFERENCES

A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. B3 “Standard Specification for Soft or Annealed Copper Wire”
2. B8 “Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft”
3. B33 “Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes”

B. Institute of Electrical and Electronics Engineers (IEEE) Publications:

1. C2 “ASC C2 Eighth Interim Collection of the National Electrical Safety Code”
2. 81 “IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements “
3. 837 “IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding”

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"
2. 780 “Standard for the Installation of Lightning Protection Systems”

D. Underwriter's Laboratories, Inc. (UL) Standards:

1. 486A “Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors”
2. 96 “Standard for Safety for Lightning Protection Components”
3. 467 “Grounding and Bonding Equipment”

1.03 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 indicating specified items selected for use in Project with the following supporting data:

1. Product Data: For the following:

- a. Ground rods.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 1. Comply with UL 467.
- B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Avendra, LLC Preferred Manufacturers:
 - 1. None.
- B. Approved Manufacturers:
 - 1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Chance/Hubbell
 - b. Copperweld Corp.
 - c. Thomas & Betts, Electrical

2.02 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Section 26 05 19 - "Low-Voltage Electrical Power Conductors and Cables."
- B. Material: Aluminum, copper-clad aluminum, and copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- E. Grounding Electrode Conductors: Stranded cable.
- F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- G. Bare Copper Conductors: Comply with the following:
 - 1. Solid Conductors: ASTM B3.
 - 2. Assembly of Stranded Conductors: ASTM B8.
 - 3. Tinned Conductors: ASTM B33.
- H. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.

3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- I. Ground Conductor and Conductor Protector for Wood Poles: As follows:
 1. No. 4 AWG minimum, soft-drawn copper conductor.
 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.
- J. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.
- K. Equipment Ground Conductor (Green) shall be included with all circuit conductors. In addition, provide a neutral conductor where applicable.

2.03 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.04 GROUNDING ELECTRODES

- A. Ground Rods: copper-clad steel.
 1. Size: 120" long by 3/4" in diameter.

PART 3 EXECUTION

3.01 APPLICATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
- F. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
 2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

3.02 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

- B. Install equipment grounding conductors in all feeders and circuits.
- C. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding 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. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- G. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- H. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- I. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.
- J. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- K. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- L. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

- M. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- N. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- O. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- P. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- Q. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

3.03 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Non-contact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted-and clamped-type connections between conductors and ground rods.
- F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

- G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.04 OVERHEAD-LINE GROUNDING

- A. Comply with IEEE C2 requirements. Use 2 or more parallel ground rods if a single ground rod electrode resistance to ground exceeds 25 ohms.
- B. Drive ground rods to a depth of 12 inches below finished grade in undisturbed earth.
- C. Ground Rod Connections: Use clamp-type connectors listed for the purpose for underground connections and connections to rods.
- D. Lightning Arresters: Separate arrester grounds from other grounding conductors.
- E. Secondary Neutral and Tank of Transformer: Interconnect and connect to grounding conductor.
- F. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.05 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a 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 tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- B. Connections to Manhole Components: Connect 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 conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- C. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and non-current-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

3.06 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test

wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.

3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - a. Equipment Rated 500 kVA and Less: 10 ohms.
 - b. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - c. Equipment Rated More Than 1000 kVA: 3 ohms.
 - d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - e. Manhole Grounds: 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Owner representative promptly and include recommendations to reduce ground resistance.

3.07 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Section 32 90 00 - "Planting." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Raceways include the following:
 - a. RMC.
 - b. PVC, Schedule 40 or 80.
 - c. EMT.
 - d. FMC.
 - e. LFMC.
 - f. LFNC.
 - g. RNC.
 - h. Wireways.
2. Boxes, enclosures, and cabinets include the following:
 - a. Device boxes.
 - b. Floor boxes.
 - c. Outlet boxes.
 - d. Pull and junction boxes.
 - e. Cabinets and hinged-cover enclosures.

B. Related Sections:

1. Section 07 84 00 - Firestopping.
2. Section 26 05 00 – Common Work Results for Electrical: For raceways and box supports.
3. Section 26 27 26 - Wiring Devices: For devices installed in boxes and for floor-box service fittings.

1.02 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. C80.1 "Electrical Rigid Steel Conduit (ERSC)"
2. C80.3 "Steel Electrical Metallic Tubing (EMT)"

B. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. ANSI/NEMA FB 1 "Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable"
2. ANSI/NEMA OS 1 "Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports"
3. 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)"
4. RN 1 "Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit"
5. TC 2 "Electrical Polyvinyl Chloride (PVC) Tubing and Conduit"
6. TC 3 "Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing"

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

- D. Occupational Safety & Health Administration (OSHA) Regulations:
 - 1. 1910.7 “Definition and Requirements for a Nationally Recognized Testing Laboratory”
- E. National Electrical Contractors Association (NECA) Publications:
 - 1. 111 “Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) (ANSI)”
- F. Underwriter's Laboratories, Inc. (UL) Standards:
 - 1. 1660 “Liquid-Tight Flexible Nonmetallic Conduit”

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. LFNC: Liquidtight flexible nonmetallic conduit.
- F. RMC: Rigid metal conduit.
- G. RNC: Rigid nonmetallic conduit.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 - 1. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.05 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electric Code".
- B. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70 "National Electric Code" Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
 - 3. Comply with NECA 111 “Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) (ANSI)”

1.06 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Avendra, LLC Preferred Manufacturers:
 - 1. Metal Conduit and Tubing:
 - a. None.
 - 2. Flexible Conduit:
 - a. None.
 - 3. Nonmetallic Conduit and Tubing:
 - a. None.
 - 4. Conduit Bodies and Fittings:
 - a. None.

5. Metal Wireways:
 - a. None.
 6. Nonmetallic Wireways:
 - a. None.
 7. Surface Metal Raceways:
 - a. None.
 8. Surface Nonmetallic Raceways:
 - a. None.
 9. Boxes, Enclosures, and Cabinets:
 - a. None.
 - B. Approved Manufacturers:
 1. Metal Conduit and Tubing:
 - a. Anixter Brothers, Inc.
 - b. Carol Cable Co., Inc.
 - c. Wheatland Tube Co.
 2. Flexible Conduit:
 - a. Carol Cable Co., Inc.
 - b. Electri-Flex Co.
 3. Nonmetallic Conduit and Tubing:
 - a. Hubbell, Inc.; Raco, Inc.
 - b. Lamson & Sessions; Carlon Electrical Products
 - c. Thomas & Betts Corp.
 4. Conduit Bodies and Fittings:
 - a. Emerson Electric Co.; Appleton Electric Co.
 - b. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - c. Lamson & Sessions; Carlon Electrical Products
 5. Metal Wireways:
 - a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.; a Division of Groupe Schneider
 6. Nonmetallic Wireways:
 - a. Hoffman Engineering Co.
 - b. Lamson & Sessions; Carlon Electrical Products
 7. Boxes, Enclosures, and Cabinets:
 - a. Hoffman Engineering Co.; Federal-Hoffman, Inc.
 - b. Hubbell Inc.; Killark Electric Manufacturing Co.
 - c. Thomas & Betts Corp.
- 2.02 METAL CONDUIT AND TUBING
- A. Rigid Steel Conduit: ANSI C80.1.
 - B. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
 - C. EMT and Fittings: ANSI C80.3.

1. Fittings: Set-screw or compression type.
 - D. FMC: Zinc-coated steel.
 - E. LFMC: Flexible steel conduit with PVC jacket.
 - F. Fittings: NEMA FB 1; compatible with conduit/tubing materials.
- 2.03 NONMETALLIC CONDUIT AND TUBING
- A. RNC: NEMA TC 2, Schedule 40 or 80 PVC.
 - B. RNC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
 - C. LFNC: UL 1660.
- 2.04 METAL WIREWAYS
- A. Material: Sheet metal sized and shaped as indicated.
 - B. Fittings and Accessories: Include 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.
 - C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
 - D. Wireway Covers: As indicated
 - E. Finish: Manufacturer's standard enamel finish.
- 2.05 NONMETALLIC WIREWAYS
- A. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections using plastic fasteners.
 - B. Fittings and Accessories: Include 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.
 - C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- 2.06 OUTLET AND DEVICE BOXES
- A. Sheet Metal Boxes: NEMA OS 1.
- 2.07 FLOOR BOXES
- A. Floor Boxes: Cast metal, fully adjustable, rectangular.
- 2.08 PULL AND JUNCTION BOXES
- A. Small Sheet Metal Boxes: NEMA OS 1.
 - B. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- 2.09 ENCLOSURES AND CABINETS
- A. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
 - B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 WIRING METHODS

- A. Outdoors: Use the following wiring methods:
 - 1. Exposed: Rigid steel.
 - 2. Concealed: Rigid steel.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.
- B. Indoors: Use the following wiring methods:
 - 1. Exposed on ceilings and wall in Mechanical Equipment Rooms galvanized rigid steel conduit.
 - 2. Concealed in spaces above hung ceiling and wall: Electrical Metallic Tubing (EMT).
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
 - 4. Damp or Wet Locations: Rigid steel conduit.
 - 5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.
- C. Underground or concrete encased:
 - 1. Schedule 40 PVC.

3.03 INSTALLATION - GENERAL

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Do not install aluminum conduits embedded in or in contact with concrete.
- C. Set floor boxes level and adjust to finished floor surface.
- D. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- E. Size all conduits supplying motors and associated control equipment to include equipment grounding conductor sized per NFPA 70 whether or not shown on the drawings or specified.
- F. Unless otherwise noted, terminate all conduits stubbing up inside rooms or roof as follows:
 - 1. Conduits for AC power: Stub up 6" above finished floor and provide concrete sill to protect stub-ups.
 - 2. On PVC conduit for AC power and control cable, provide PVC to galvanized steel rigid conduit adaptor.
 - 3. Plug or cap all conduits during construction or until permanent conductors are installed. Taped ends will not be allowed.
- G. In exposed conduit runs longer than 300 feet, expansion fittings shall be installed. Where embedded conduit crosses a structural expansion joint, expansion and deflection fitting shall be installed.

- H. Tighten set screws of threadless fittings with suitable tools.
- I. Complete raceway installation before starting conductor installation.

3.04 INSTALLATION - RACEWAYS

- A. Minimum Raceway Size: 3/4-inch trade size (DN21).
- B. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Install raceways level and square and at proper elevations. Provide adequate headroom.
- E. Support raceways as specified in Section 26 05 00 - "Basic Electrical Materials and Methods."
- F. Use temporary closures to prevent foreign matter from entering raceways.
- G. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- H. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- I. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
- J. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- K. Raceways Embedded in Slabs: Install in middle third of slab thickness where practical, and leave at least 1-inch concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Run conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit or rigid steel conduit, before rising above floor.
- L. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
 - 1. Run parallel or banked raceways together, on common supports where practical.
 - 2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- M. Join raceways with fittings designed and approved for the purpose and make joints tight.
 - 1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 - 2. Use insulating bushings to protect conductors.
- N. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.

- O. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- P. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.
- Q. Telephone and Signal System Raceways, 2-Inch Trade Size (DN53) and Smaller: In addition to the above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

3.05 INSTALLATION - ACCESSORIES

- A. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-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 at the following points:
 - 1. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- B. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
- C. Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
- D. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

3.06 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.07 CLEANING

- A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION

SECTION 26 05 36 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes [**steel**] [**aluminum**] cable trays and accessories.

1.2 SUBMITTALS

- A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
 - 1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
 - a. Design Calculations: Calculate requirements for selecting seismic restraints.
 - b. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.
- C. Field quality-control reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Chalfant Manufacturing Company.
 2. Cooper B-Line, Inc.
 3. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.
 4. GS Metals Corp.; GLOBETRAYS Products.
 5. MONO-SYSTEMS, Inc.
 6. MPHusky.
 7. PW Industries.
 8. **<Insert manufacturer's name.>**

2.2 MATERIALS AND FINISHES

- A. Cable Trays, Fittings, and Accessories: Steel, complying with NEMA VE 1.
1. Factory-standard primer, ready for field painting; with cadmium-plated hardware according to ASTM B 766.
 2. Mill galvanized before fabrication, complying with ASTM A 653/A 653M, **G90 (Z275)** coating; with hardware **[galvanized according to ASTM B 633] [cadmium plated according to ASTM B 766]**.
 3. Electrogalvanized before fabrication, complying with ASTM B 633; with hardware galvanized according to ASTM B 633.
 4. Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M, Class B2; with **[chromium-zinc, ASTM F 1136] [Type 316 stainless-steel]** hardware.
 5. Epoxy-resin paint over paint manufacturer's recommended primer and corrosion-inhibiting treatment; with **[cadmium-plated hardware according to ASTM B 766] [Type 316 stainless-steel hardware]**.
 6. **<Insert finish.>**
- B. Cable Trays, Fittings, and Accessories: Aluminum, complying with NEMA VE 1, Aluminum Association's Alloy 6063-T6 for rails, rungs, and cable trays, and Alloy 5052-H32 or Alloy 6061-T6 for fabricated parts; with **[chromium-zinc, ASTM F 1136] [Type 316 stainless-steel]** splice-plate fasteners, bolts, and screws.
- C. Sizes and Configurations: Refer to the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
1. Center-hanger supports may be used only when specifically indicated.

2.3 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Covers: **[Solid] [Louvered] [Ventilated-hat] [2-in-3 pitch cover]** type of same materials and finishes as cable tray.
- C. Barrier Strips: Same materials and finishes as cable tray.

- D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 WARNING SIGNS

- A. Lettering: **1-1/2-inch- (40-mm-)** high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."
- B. Materials and fastening are specified in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.
- B. Remove burrs and sharp edges from cable trays.
- C. Fasten cable tray supports to building structure[**and install seismic restraints**].
 - 1. Design each fastener and support to carry load indicated by seismic requirements[**and to comply with seismic-restraint details according to Division 26 Section "Vibration and Seismic Controls for Electrical Systems."**]
 - 2. Place supports so that spans do not exceed maximum spans on schedules.
 - 3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
 - 4. Support bus assembly to prevent twisting from eccentric loading.
 - 5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
 - 6. Locate and install supports according to [NEMA FG 1] [NEMA VE 1].
- D. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.
- E. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in [NEMA FG 1] [NEMA VE 1]. Space connectors and set gaps according to applicable standard.
- F. Make changes in direction and elevation using standard fittings.
- G. Make cable tray connections using standard fittings.

- H. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- I. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- J. Workspace: Install cable trays with enough space to permit access for installing cables.
- K. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- L. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.
- M. Install cables only when cable tray installation has been completed and inspected.
- N. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- O. On vertical runs, fasten cables to tray every **18 inches (457 mm)**. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- P. In existing construction, remove inactive or dead cables from cable tray.
- Q. Install covers after installation of cable is completed.
- R. Ground cable trays according to manufacturer's written instructions.
- S. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

3.2 FIELD QUALITY CONTROL

- A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
 - 1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
 - 3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
 - 4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.

6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.
- B. Report results in writing.

END OF SECTION 260536

SECTION 26 05 48 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It complements optional seismic construction requirements in the various electrical component Sections.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete
 - 2. Section 04 20 00 - Unit Masonry
 - 3. Section 05 12 00 - Structural Steel
 - 4. Section 06 10 00 - Rough Carpentry
 - 5. Section 26 05 00 – Common Work Results for Electrical

1.02 REFERENCES

- A. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)
 - 1. A36 “Standard Specification for Carbon Structural Steel”
 - 2. A325 "Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength"
 - 3. A575 - 96 “Standard Specification for Steel Bars, Carbon, Merchant Quality, M Grades”
 - 4. A576 - 90b “Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality”
 - 5. A603 "Standard Specification for Zinc-Coated Steel Structural Wire Rope"
 - 6. A1011 "Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability"
- B. Manufacturers Standardization Society of the Valve and Fittings Industry. (MSS) Publications:
 - 1. SP-69 “ANSI/MSS Edition Pipe Hangers and Supports - Selection and Application”

1.03 DEFINITIONS

- A. IBC: International Building Code
- B. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.
- C. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements during an earthquake.

1.04 SUBMITTALS

- A. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:

1. Product Data:
 - a. Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic restraint component used.
 - b. Anchor Bolts and Studs: Tabulate types and sizes, complete with report numbers and rated strength in tension and shear as evaluated by an agency approved by authorities having jurisdiction.
2. Shop Drawings: For anchorage and bracing not defined by details and charts on Drawings. Indicate materials, and show designs and calculations signed and sealed by a professional engineer.
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacings, identifying components and listing their strengths. Indicate direction and value of forces transmitted to the structure during seismic events.
3. Preapproval and Evaluation Documentation: By an agency approved by authorities having jurisdiction, showing maximum ratings of restraints and the basis for approval (tests or calculations).
4. Coordination Drawings: Plans and sections drawn to scale and coordinating seismic bracing for electrical components with other systems and equipment, including other seismic restraints, in the vicinity.
5. Product Certificates: Signed by manufacturers of seismic restraints certifying that products furnished comply with requirements.
6. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
7. Material Test Reports: From a qualified testing agency indicating and interpreting test results of seismic control devices for compliance with requirements indicated.

1.05 QUALITY ASSURANCE

- A. Comply with seismic restraint requirements in IBC unless requirements in this Section are more stringent.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing seismic engineering services, including the design of seismic restraints, that are similar to those indicated for this Project.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

1.06 PROJECT CONDITIONS

- A. Project Seismic Hazard Exposure Group as Defined in IBC: II.

1.07 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Avendra, LLC Preferred Manufacturers:

1. None.

B. Approved Manufacturers:

1. B-Line Systems, Inc
2. Thomas & Betts Corp
3. Unistrut Corporation

2.02 MATERIALS

A. Use the following materials for restraints:

1. Indoor Dry Locations: Steel, zinc plated.
2. Outdoors and Damp Locations: Galvanized steel.

2.03 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A325.

E. Welding Lugs: Comply with MSS SP-69, Type 57.

F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.04 SEISMIC BRACING COMPONENTS

A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.

1. Materials for Channel: ASTM A1011, GR 33.
2. Materials for Fittings and Accessories: ASTM A575, ASTM A576, or ASTM A36.
3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

- B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.
- C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.
 - 1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
 - 2. Wire Rope Cable: Comply with ASTM A603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.
- D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install seismic restraints according to applicable codes and regulations and as approved by authorities having jurisdiction, unless more stringent requirements are indicated.

3.02 STRUCTURAL ATTACHMENTS

- A. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.
- B. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.
- C. Attachments to Existing Concrete: Use expansion anchors.
- D. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
- E. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.
- F. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.
- G. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

3.03 ELECTRICAL EQUIPMENT ANCHORAGE

- A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.
- B. Anchor panelboards, motor-control centers, motor controls, switchboards, switchgear, transformers, unit substations, fused power-circuit devices, transfer switches, busways, battery racks, static uninterruptible power units, power conditioners, capacitor units, communication system components, and electronic signal processing, control, and distribution units as follows:
 - 1. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
 - 2. Concrete Bases for Floor-Mounted Equipment: Use female expansion anchors and install studs and nuts after equipment is positioned.
 - 3. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.

4. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
5. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

3.04 SEISMIC BRACING INSTALLATION

- A. Install bracing according to spacings and strengths indicated by approved analysis.
- B. Expansion and Contraction: Install to allow for thermal movement of braced components.
- C. Cable Braces: Install with maximum cable slack recommended by manufacturer.
- D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.05 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Make flexible connections in raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform the following field quality-control testing:
 1. Testing: Test pull-out resistance of seismic anchorage devices.
 - a. Provide necessary test equipment required for reliable testing.
 - b. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - c. Schedule test with Owner, through Owner representative, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
 - d. Obtain Owner's representative approval before transmitting test loads to the structure. Provide temporary load-spreading members.
 - e. Test at least four of each type and size of installed anchors and fasteners selected by Owner representative.
 - f. Test to 90 percent of rated proof load of device.
 - g. If a device fails the test, modify all installations of same type and retest until satisfactory results are achieved.
 - h. Record test results.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

B. Related Sections:

1. Section 26 05 19– Low Voltage Electrical Power Conductors and Cables
2. Section 26 05 33 - Raceways and Boxes for Electrical Systems
3. Section 26 24 00– Switchboards and Panel Boards
4. Section 26 27 26 - Wiring Devices
5. Section 26 28 16 - Enclosed Switches and Circuit Breakers

1.02 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. ANSI/ASME A13.1 “Scheme for the Identification of Piping Systems”

B. Institute of Electrical and Electronics Engineers (IEEE) Publications:

1. C2 “ASC C2 Eighth Interim Collection of the National Electrical Safety Code”

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

1.03 SUBMITTALS

A. Submit “Letter of Conformance” in accordance with Section 01 33 00 (01330) indicating specified items selected for use in Project with the following supporting data:

1. Product Data: For each electrical identification product indicated.

1.04 QUALITY ASSURANCE

A. Comply with IEEE C2.

B. Comply with NFPA 70 "National Electric Code”

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers:

1. Brady USA, Inc.
2. Panduit corp.
3. Seton Identification Products

2.02 RACEWAY AND CABLE LABELS

A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on orange field.
2. Legend: Indicates voltage
- B. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.
- C. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- D. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
 1. Not less than 6 inches wide by 4 mils thick.
 2. Compounded for permanent direct-burial service.
 3. Embedded continuous metallic strip or core.
 4. Printed legend indicating type of underground line.
- E. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- F. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- G. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.
- H. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch thick, laminated with moisture-resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.

2.03 NAMEPLATES AND SIGNS

- A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.04 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: According to color-coding.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before applying.
- E. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
 1. Bands: Pre-tensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
 2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
 3. Apply the following colors to the systems listed below:
 - a. Fire Alarm System: Red.
 - b. Fire-Suppression Supervisory and Control System: Red and yellow.
 - c. Combined Fire Alarm and Security System: Red and blue.
 - d. Security System: Blue and yellow.
 - e. Mechanical and Electrical Supervisory System: Green and blue.
 - f. Telecommunication System: Green and yellow.
- F. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.
- G. Circuit Identification Labels on Boxes: Install labels externally.
 1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
 2. Concealed Boxes: Plasticized card-stock tags.
 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

- H. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.
- I. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system.
 - 1. Color-code 208/120-V system as follows:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - e. Ground: Green.
 - 2. Color-code 480/277-V system as follows:
 - a. Phase A: Yellow.
 - b. Phase B: Brown.
 - c. Phase C: Orange.
 - d. Neutral: White with a colored stripe or gray.
 - e. Ground: Green.
 - 3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
 - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a 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. Use 1-inch wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
 - b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.
- J. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.
 - 1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 - 2. Tag Fasteners: Nylon cable ties.
 - 3. Band Fasteners: Integral ears.
- K. Apply identification to conductors as follows:
 - 1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.

2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
 3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
- L. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- M. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch high lettering on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:
1. Panelboards, electrical cabinets, and enclosures.
 2. Access doors and panels for concealed electrical items.
 3. Electrical switchgear and switchboards.
 4. Emergency system boxes and enclosures.
 5. Disconnect switches.
 6. Enclosed circuit breakers.
 7. Motor starters.
 8. Push-button stations.
 9. Power transfer equipment.
 10. Contactors.
 11. Remote-controlled switches.
 12. Dimmers.
 13. Control devices.
 14. Transformers.
 15. Telephone switching equipment.
 16. Fire alarm master station or control panel.
 17. Security-monitoring master station or control panel.

END OF SECTION

SECTION 26 24 00 - SWITCHBOARDS AND PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Service and Distribution Switchboards Rated 600 V and Less.
2. Load Centers and Panelboards, Overcurrent Protective Devices, And Associated Auxiliary Equipment Rated 600 V and Less For The Following Types:
 - a. Lighting and Appliance Branch-Circuit Panelboards.
 - b. Distribution Panelboards.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete.
2. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
3. Section 26 05 48- Vibration and Seismic Controls for Electrical Work.
4. Section 26 05 53- Identification for Electrical Systems.

1.02 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. C39.1 "Requirements For Electrical Analog Indicating Instruments

B. Institute of Electrical and Electronics Engineers (IEEE) Publications:

1. C57.13 "IEEE "Standard Requirements for Instrument Transformers"

C. InterNational Electrical Testing Association (NICET)

D. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)"
2. AB 1 "Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures"
3. EI 21.1, "Instrument Transformers for Revenue Metering (110 kV BIL and less)"
4. FU 1 "Low Voltage Cartridge Fuses"
5. PB 1 "Panelboards"
6. PB 1.1 "General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less"
7. PB 2 "Deadfront Distribution Switchboards"
8. PB 2.1 "General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less"

E. National Institute for Certification in Engineering Technologies (NETA)

1. ATS "Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems"

F. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"
 - G. Underwriter's Laboratories, Inc. (UL) Standards:
 1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
 2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"
- 1.03 DEFINITIONS
- A. EMI: Electromagnetic interference.
 - B. GFCI: Ground-fault circuit interrupter.
 - C. RFI: Radio-frequency interference.
 - D. RMS: Root mean square.
 - E. SPDT: Single pole, double throw.
 - F. TVSS: Transient voltage surge suppressor.
- 1.04 SUBMITTALS
- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 indicating specified items selected for Project with the following supporting data:
 1. Product Data:
 - a. For each type of switchboard, panelboard, overcurrent protective device, TVSS device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 2. Shop Drawings: For each switchboard, panelboard and related equipment.
 - a. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - 1) Enclosure types and details for types other than NEMA 250, Type 1.
 - 2) Bus configuration, current, and voltage ratings.
 - 3) Short-circuit current rating of switchboards and overcurrent protective devices.
 - 4) Descriptive documentation of optional barriers specified for electrical insulation and isolation.
 - 5) Utility company's metering provisions with indication of approval by utility company.
 - 6) UL listing for series rating of installed devices.
 - 7) Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - b. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
 3. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
 4. Field Test Reports: Submit written test reports and include the following:

- a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
5. Manufacturer's field service report.
6. Updated mimic-bus diagram for switchboard reflecting field changes after final switchboard load connections have been made, for record.
7. Maintenance Data: For Switchboards, Panelboards and components to include in maintenance manuals specified in Division 01. In addition to requirements specified in Division 01 Section "Contract Closeout," include the following:
 - a. Routine maintenance requirements for switchboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - c. Time-current curves, including selectable ranges for each type of overcurrent protective device.
8. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA PB 2 for switchboards.
- D. Comply with NEMA PB1 for panelboards.
- E. Comply with NFPA 70.
- F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards, including clearances between switchboards, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in sections of lengths that can be moved past obstructions in delivery path.
- B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. Handle switchboards according to NEMA PB 2.1.

1.07 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations: Rate equipment for continuous operation under the following, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.08 COORDINATION

- A. Coordinate layout and installation of switchboards, panelboards, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

PART 2 PRODUCT

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Switchboards:
 - a. Eaton Corp.; Cutler-Hamer Products
 - b. General Electric Co.; Electrical Distribution & Control Div.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D Co.; a Division of Groupe Schneider
 - 2. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corp.; Cutler-Hammer Products
 - b. General Electric Co.; Electrical Distribution & Control Div.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D Co.; a Division of Groupe Schneider

2.02 SWITCHBOARDS - MANUFACTURED UNITS

- A. Front-Connected, Front-Accessible Switchboard Fixed, individually mounted main device, panel-mounted branches, and sections rear aligned.
- B. Nominal System Voltage: 208 Y/120 V.
- C. Main-Bus Continuous: 2000A.

2.03 SWITCHBOARDS - FABRICATION AND FEATURES

- A. Enclosure: Steel: NEMA 250, Type 3R.
- B. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- C. Barriers: Between adjacent switchboard sections.

- D. Utility Metering Compartment: Fabricated compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.
- E. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- F. Hinged Front Panels: Allow access to circuit-breaker, metering, accessory, and blank compartments.
- G. Buses and Connections: Three phase, four wire, unless otherwise indicated. Include the following features:
 - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity or tin-plated, high-strength, electrical-grade aluminum alloy.
 - a. If bus is aluminum, use copper or tin-plated aluminum for circuit-breaker line connections.
 - b. If bus is copper, use copper for feeder circuit-breaker line connections.
 - 2. Ground Bus: 1/4-by-2-inch minimum size, drawn-temper copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - 3. Contact Surfaces of Buses: Silver plated for copper to copper and copper to aluminum connections, silver or tin plating for aluminum to aluminum connections.
 - 4. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 5. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
 - 6. Neutral Buses: 100 percent of the ampacity of the phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus is braced.
- H. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.04 SWITCHBOARDS - INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:
 - 1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
 - 2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
 - 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.
- B. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1.
 - 1. Meters: 4-inch diameter or 6 inches square, flush or semi-flush, with anti-parallax 250-degree scales and external zero adjustment.
 - 2. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.
- C. Instrument Switches: Rotary type with off position.

1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
 2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.
- D. Feeder Ammeters: 2-1/2-inch minimum size with 90- or 120-degree scale. Meter and transfer device with an off position, located on overcurrent device door for indicated feeder circuits only.

2.05 SWITCHBOARDS - CONTROL POWER

- A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.06 PANELBOARDS - FABRICATION AND FEATURES

- A. Enclosures: Flush- and/or surface-mounted cabinets as indicated on drawings. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
 1. Outdoor Locations: NEMA 250, Type 3R.
 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- F. Bus: Hard-drawn copper, 98 percent conductivity or tin-plated aluminum.
- G. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- I. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- J. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
- K. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- L. Gutter Barrier: Arrange to isolate individual panel sections.

- M. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.07 PANELBOARDS - SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.08 PANELBOARDS - LIGHTING AND APPLIANCE BRANCH-CIRCUITS

- A. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.09 PANELBOARDS - DISTRIBUTION

- A. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
- B. Main Overcurrent Protective Devices: Circuit breaker.
- C. Branch overcurrent protective devices shall be one of the following:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.
 - 2. 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.

2.10 LOAD CENTERS

- A. Overcurrent Protective Devices: Plug-in, full-module circuit breaker.
- B. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.11 SWITCHBOARD AND PANELBOARDS - OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, 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 Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with 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. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with [5] [30]-mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

2.12 ACCESSORY COMPONENTS AND FEATURES

- A. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.13 IDENTIFICATION

- A. Mimic Bus for Switchboard: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram. Coordinate mimic-bus segments with devices in switchboard sections to which applied. Produce a concise visual presentation of principal switchboard components and connections.
- B. Presentation Media: Painted graphics in color contrasting with equipment factory-finished background to represent bus and components, complete with lettered designations.

PART 3 EXECUTION

3.01 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.02 EXAMINATION

- A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Install panelboards and accessories according to NEMA PB 1.1
- C. Support switchboards on concrete bases, 4-inch nominal thickness.

- D. Comply with mounting and anchoring requirements specified in Section 26 05 48 "Seismic Controls for Electrical Work."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- F. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- G. Mounting of Panelboards: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- H. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- I. Install filler plates in unused spaces.
- J. Provision for Future Circuits at Flush Panelboards: 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. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.04 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 26 05 53 "Identification for Electrical Systems".
- B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.
- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.05 CONNECTIONS

- A. Install equipment grounding connections for switchboards with ground continuity to main electrical ground bus.
- B. 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 and UL 486B.

3.06 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: After installing switchboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Infrared Scanning: Switchboard only. After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panel so joints and connections are accessible to portable scanner.
 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 3. Record of Infrared Scanning: Prepare a certified report that identifies switchboards checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- D. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 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.

3.07 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.08 CLEANING

- A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Receptacles, Connectors, Switches, and Finish Plates.
- B. Related Sections:
 - 1. Section 00 31 13.43 - Interior Finish Index
 - 2. Section 25 51 10 – Integrated Automation Control of Guestroom Equipment
 - 3. Section 26 05 53– Identification for Electrical Systems.

1.02 REFERENCES

- A. National Electrical Manufacturer's Association (NEMA) Standards Publications:
 - 1. WD 1 "General Color Requirements for Wiring Devices"
 - 2. WD 6 "Wiring Devices—Dimensional Requirements"
- B. National Fire Protection Association (NFPA) Publications:
 - 1. 70 "National Electric Code"
- C. Underwriter's Laboratories, Inc. (UL) Publications:
 - 1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
 - 2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"
 - 3. 498 "Attachment Plugs and Receptacles"
 - 4. 1310 "Standard for Class 2 Power Units"

1.03 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 - 1. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 01.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.

1.06 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described in Section 01 78 43 "Spare Parts and Materials" that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers:

1. Receptacles, Switches and Wall Plates
 - a. Legrand
 - b. Leviton Manufacturing Co., Inc.
 - c. Lutron Electronics Company, Inc
 - d. Cooper Wiring Devices by Eaton
2. Wiring Devices:
 - a. GE Company; GE Wiring Devices
 - b. Hubbell, Inc.; Wiring Devices Div.
 - c. Killark Electric Manufacturing Co.
 - d. Legrand
 - e. Leviton Manufacturing Co., Inc.
3. Illuminated Night Light with Sensor
 - a. Legrand
4. Pendant Cord and Connector Devices
 - a. GE Company; GE Wiring Devices
 - b. Hubbell, Inc.; Wiring Devices Div.
 - c. Killark Electric Manufacturing Co.
 - d. Legrand
 - e. Leviton Manufacturing Co., Inc.
5. Cord and Plug Sets
 - a. GE Company; GE Wiring Devices
 - b. Hubbell, Inc.; Wiring Devices Div.
 - c. Killark Electric Manufacturing Co.
 - d. Legrand
 - e. Leviton Manufacturing Co., Inc.
6. Multioutlet Assemblies:
 - a. Airey-Thompson Co.
 - b. Wiremold
7. Poke-through, Floor Service Outlets and Telephone/Power Poles:
 - a. Hubbell, Inc.; Wiring Devices Div.
 - b. Legrand
 - c. Square D Co.; a Division of Groupe Schneider
 - d. Wiremold.

2.02 RECEPTACLES

- A. Straight Blade and Locking Type Receptacles: General duty grade, NEMA 5-20R duplex type.
- B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.

- C. Isolated-Ground Receptacles: Equipment grounding contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from mounting strap.
 - 1. Devices: Listed and labeled as isolated-ground receptacles.
 - 2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.
- D. Combination USB Charger Receptacles:
 - 1. Standard AC Duplex receptacle with two USB charging ports rated at 2.1 A, UL listed to UL 498 and UL 1310.
 - a. Device shall have one AC outlet and two USB charging ports (2.1 A @ 5 V DC).
 - b. USB ports shall be work with USB 2.0 and 3.0 compatible devices.
 - c. Device shall have auto grounding feature.
 - d. Where shown on Drawings as ground-fault protected, device shall be wired from load-side of a GFCI receptacle.
 - e. Device shall be compatible with standard wall plates.

2.03 SWITCHES

- A. Toggle Switches:
 - 1. Snap Switches: General-duty, quiet type.
 - 2. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
 - a. Switch: 20 A, 120/277-VAC.
 - b. Receptacle: NEMA WD 6, Configuration 5-15R.
 - 3. Where more than one switch occurs at the same location, they shall be ganged under one plate. Where space does not permit horizontal ganging, interchangeable type switches may be used, only with approval of the Owner's Representative.
 - 4. Locations:
 - a. Refer to Drawings.
- B. Rocker Switches and matching Receptacles:
 - 1. Switches shall be 15 AMP; 120/277 VAC, side-wired with grounding screw similar to "Decora Devices" as manufactured by Leviton Manufacturing Co., Inc., or approved substitution by listed manufacturers.
 - 2. Switch and matching cover plate that hides the screws.
 - 3. Where more than one switch occurs at the same location, they shall be ganged under one plate. Where space does not permit horizontal ganging, interchangeable type switches may be used, only with approval of the Owner's Representative.
 - 4. Locations:
 - a. Public Spaces.
 - b. Lobby Space.
 - c. Guestrooms.
- C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.
 - 1. Control: Continuously adjustable slide. Single-pole or three-way switch to suit connections.

2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable slide; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch wire connecting leads.
3. Fluorescent Lamp Dimmers: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming to a maximum of 1 percent of full brightness, with filters to reduce audible noise, RF and TV interference.

2.04 WALL PLATES

- A. Single and combination types match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Provide plates for all devices and outlets with opening configuration suitable for devices to be covered.
 3. Plates shall be smooth urea plastic secured in place with screws finished to match the plates. Back of the house areas, such as equipment spaces, shall have steel plates. Stainless steel plates shall be used in kitchens. Weatherproof plates shall be used where exposed to the weather or in pool area.
 4. Color:

<u>Device Location</u>	<u>Type</u>	<u>Wall Finish</u> <u>(Int. Finish</u> <u>Index #)</u>	<u>Color</u>
a. Guestrooms	Rocker	Varies	White
b. Public Space	Rocker	Varies	White
c. Buffet:	Rocker	Varies	Stainless Steel Cover Plates with Black Devices
d. Back-of-House	Toggle	Varies	White
e. All other locations:	Toggle	Varies	White
f. Color of devices shall match cover plates, unless noted otherwise.			

2.05 PENDANT CORD/CONNECTOR DEVICES

- A. Description: Matching, locking type, plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, Heavy-Duty grade.
 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.06 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.07 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartmentation: Barrier separates power and signal compartments.
- C. Housing Material: Die-cast aluminum, satin finished.
- D. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.
- E. Signal Outlet: Blank cover with bushed cable opening, unless otherwise indicated.

2.08 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box unit with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
 - 1. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
 - 2. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 - 3. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
 - 4. Wiring: Three No. 12 AWG power and ground conductors; one 75-ohm coaxial telephone/data cable; and one four-pair, 75-ohm telephone/data cable.

2.09 MULTIOUTLET ASSEMBLIES

- A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- B. Raceway Material: Metal, with manufacturer's standard finish.
- C. Wire: No. 12 AWG.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Protect devices and assemblies during painting. Install wall plates when painting is complete.
- C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.
- D. Do not share neutral conductor on load side of dimmers.
- E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- F. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

3.02 IDENTIFICATION

- A. Comply with Section 26 05 53 "Identification for Electrical Systems."
 - 1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
 - 2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.03 CONNECTIONS

- A. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

- B. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.
- C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
- B. Check TVSS receptacle indicating lights for normal indication.
- C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- D. Replace damaged or defective components.

3.05 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Individually Mounted Switches and Circuit Breakers Used for the following:
 - a. Service Disconnect Switches.
 - b. Feeder And Equipment Disconnect Switches.
 - c. Feeder Branch-Circuit Protection.
 - d. Motor Disconnect Switches.

B. Related Sections:

1. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: For fuses in fusible disconnect switches.
2. Section 26 05 53 - Identification for Electrical Systems.
3. Section 26 24 00 - Switchboards and Panelboards: For individually enclosed, fused power-circuit devices used as feeder disconnect switches.
4. Section 26 27 26 - Wiring Devices: For attachment plugs and receptacles, and snap switches used for disconnect switches.

1.02 REFERENCES

A. InterNational Electrical Testing Association (NICET)

B. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. AB 1 "Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures"
2. FU 1 "Low Voltage Cartridge Fuses"
3. KS 1 "Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)"

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

D. National Institute for Certification in Engineering Technologies (NETA)

1. ATS "Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems"

E. Occupational Safety & Health Administration (OSHA) Regulations:

1. OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907
2. 1910.7 "Definition and Requirements for a Nationally Recognized Testing Laboratory"

F. Underwriter's Laboratories, Inc. (UL) Standards:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"

1.03 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 indicating specified items selected for use in Project with the following supporting data:
1. Product Data:
 - a. Descriptive data and time-current curves.
 - b. Let-through current curves for circuit breakers with current-limiting characteristics.
 - c. Coordination charts and tables and related data.
 2. Wiring diagrams detailing wiring for power and control systems and differentiating between manufacturer-installed and field-installed wiring.
 3. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of owners representative and owners, and other information specified.
 4. Field test reports indicating and interpreting test results.
 5. Maintenance data for tripping devices to include in the operation and maintenance manual specified in Division 01.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: In addition to the requirements specified in Section 01 45 00 - "Quality Control," an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the InterNational Electrical Testing Association (NICET)
1. Testing Agency's Field Supervisor: Person currently certified by NETA or InterNational Electrical Testing Association (NICET), to supervise on-site testing specified in Part 3 of this Specification Section.
- B. Source Limitations: Obtain disconnect switches and circuit breakers from one source and by a single manufacturer.
- C. Comply with NFPA 70 for components and installation.
- D. Listing and Labeling: Provide disconnect switches and circuit breakers specified in this Section that are listed and labeled.
1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
1. Disconnect Switches/Fusible Switches & Circuit Breakers:
 - a. General Electric Co.; Electrical Distribution and Control Division
 - b. Siemens Energy & Automation, Inc.

- c. Square D Co.; a Division of Groupe Schneider
- d. Eaton Corp. Cutler-Hammer Products

2.02 DISCONNECT SWITCHES

- A. Enclosed, Non-fusible Switch: NEMA KS 1, Type HD, with lockable handle.
- B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position.
- C. Enclosure: NEMA KS 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.
 - 1. Outdoor Locations: Type 3R.
 - 2. Kitchen Areas: Type 4X, stainless steel.
 - 3. Other Wet or Damp Indoor Locations: Type 4.

2.03 ENCLOSED CIRCUIT BREAKERS

- A. Enclosed, Molded-Case Circuit Breaker: NEMA AB 1, with lockable handle.
- B. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting rating to meet available fault current.
- C. Application Listing: Appropriate for application, including switching fluorescent lighting loads or heating, air-conditioning, and refrigerating equipment.
- D. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.
- E. Circuit Breakers, 400 A and Larger: Field-adjustable, short-time and continuous-current settings.
- F. Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.
- G. Current Limiters: Where indicated, integral fuse listed for circuit breaker.
- H. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
- I. Shunt Trip: Where indicated.
- J. Accessories: On drawings.
- K. Enclosure: NEMA AB 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.
 - 1. Outdoor Locations: Type 3R.
 - 2. Kitchen Areas: Type 4X, stainless steel.
 - 3. Other Wet or Damp Indoor Locations: Type 4.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install disconnect switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.
- B. Install disconnect switches and circuit breakers level and plumb.

- C. Install wiring between disconnect switches, circuit breakers, control, and indication devices.
- D. Connect disconnect switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- E. Identify each disconnect switch and circuit breaker according to requirements specified in Section 26 05 53 (16075) - "Electrical Identification."

3.02 FIELD QUALITY CONTROL

- A. Testing: After installing disconnect switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for disconnect switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
- B. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.03 ADJUSTING

- A. Set field-adjustable disconnect switches and circuit-breaker trip ranges as indicated or as directed in coordination study report.

3.04 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION

SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. AC Motor-Control Devices Rated 600 V and Less that are Supplied as Enclosed Units.
 - a. Manual Motor Controllers
 - b. Magnetic Motor Controllers
 - c. Variable-Frequency Controllers
 - d. Enclosed Timer Switches
 - e. Enclosures

B. Related Sections include the following:

1. Section 03 30 00 - Cast-In-Place Concrete.
2. Section 26 05 00– Common Work Results for Electrical.
3. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
4. Section 26 05 53– Identification for Electrical Systems.

1.02 REFERENCES

A. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)"
2. AB 1 "Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures"
3. ICS 2 "Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 6000 Volts"
4. KS 1 "Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)"
5. MG 1 "Motors and Generators"

B. National Institute for Certification in Engineering Technologies (NETA):

1. ATS "Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems"

C. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

D. Occupational Safety & Health Administration (OSHA) Regulations:

1. 1910.7 "Definition and Requirements for a Nationally Recognized Testing Laboratory"

E. Underwriter's Laboratories, Inc. (UL) Standards:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"

1.03 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 indicating specified items selected for use in project with the following supporting data:
 - 1. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
 - 2. Maintenance Data: For products to include in the maintenance manuals specified in Division 01.
 - 3. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
 - 4. Qualification Data for Field Testing Agency: Certificates, signed by Contractor, certifying that agency complies with requirements specified in "Quality Assurance" Article below.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.
- B. Comply with NFPA 70.
- C. Listing and Labeling: Provide motor controllers specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

1.05 COORDINATION

- A. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.
- B. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

1.06 EXTRA MATERIALS

- A. Furnish extra materials described in Section 01 78 43 "Spare Parts and Material" that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Deliver extra materials to Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary
 - 2. Allen-Bradley Co.; Industrial Control Group
 - 3. Crouse-Hinds ECM.; Cooper Industries, Inc. Div.
 - 4. Eaton Corp.; Westinghouse & Cutler-Hammer Products

5. General Electric Co.; Electrical Distribution & Control Div
6. Siemens Energy & Automation, Inc.
7. Square D Co.; a Division of Groupe Schneider

2.02 MANUAL MOTOR CONTROLLERS

- A. Description: NEMA ICS 2, general purpose, Class A with toggle action and overload element.

2.03 MAGNETIC MOTOR CONTROLLERS

- A. Description: NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated.
- B. Control Circuit: 120 V; obtained from integral control power transformer, unless otherwise indicated. Include a control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
- C. Combination Controller: Factory-assembled combination controller and disconnect switch with or without overcurrent protection as indicated.
 1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses indicated. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a Nationally Recognized Testing Laboratory.
 2. Non-fusible Disconnect: NEMA KS 1, heavy-duty, non-fusible switch.
 3. Circuit-Breaker Disconnect: NEMA AB 1, motor-circuit protector with field-adjustable short-circuit trip coordinated with motor locked-rotor amperes.
- D. Overload Relay: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect, and with appropriate adjustment for duty cycle.

2.04 ENCLOSURES

- A. Description: Flush or surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to meet environmental conditions at installed location.
 1. Outdoor Locations: NEMA 250, Type 3R.
 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.05 ACCESSORIES

- A. Devices are factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
- C. Stop and Lockout Push-Button Station: Momentary-break push-button station with a factory-applied hasp arranged so a padlock can be used to lock push button in depressed position with control circuit open.
- D. Control Relays: Auxiliary and adjustable time-delay relays.
- E. Elapsed Time Meters: Heavy duty with digital readout in hours.

- F. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.
- G. Impulse sparkover voltage coordinated with system circuit voltage.
- H. Factory mounted with Nationally Recognized Testing Laboratory listed and labeled mounting device.

PART 3 EXECUTION

3.01 GENERAL

- A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.
- C. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.
- D. Use manual controllers for 3-phase motors up to 7-1/2 hp not requiring automatic or remote control.
- E. Push-Button Stations: In covers of magnetic controllers for manually started motors where indicated, start contact connected in parallel with sealing auxiliary contact for low-voltage protection.
- F. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.

3.02 INSTALLATION

- A. Install independently mounted motor-control devices according to manufacturer's written instructions.
- B. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components, including the pretesting and adjustment of solid-state controllers.
- C. Location: Locate controllers within sight of motors controlled.
- D. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks conforming to Section 26 05 00 - "Common Work Results for Electrical."
- E. Install freestanding equipment on concrete housekeeping bases conforming to Section 03 30 00 - "Cast-in-Place Concrete."
- F. Motor-Controller Fuses: Install indicated fuses in each fusible switch.

3.03 IDENTIFICATION

- A. Identify motor-control components and control wiring according to Section 26 05 53 "Electrical Identification."

3.04 CONTROL WIRING INSTALLATION

- A. Install wiring between motor-control devices according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.

- C. Connect hand-off-automatic switch and other automatic control devices where available.
 - 1. Connect selector switches to bypass only the manual and automatic control devices that have no safety functions when switch is in the hand position.
 - 2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.05 CONNECTIONS

- A. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.06 FIELD QUALITY CONTROL

- A. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
 - 2. Remove and replace malfunctioning units with new units, and retest.

3.07 CLEANING

- A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

3.08 DEMONSTRATION

- A. Training: Engage a factory-authorized service representative to demonstrate solid-state and variable- speed controllers and train Owner's maintenance personnel.
 - 1. Conduct training as specified in Section 01 79 00 - "Training".
 - 2. Include training relating to equipment operation and maintenance procedures.

END OF SECTION

SECTION 26 41 13 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes lightning protection for **[structures]** **[structure elements]** **[building site components]**.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminals and mounting accessories.
 - 1. Layout of the lightning protection system, along with details of the components to be used in the installation.
 - 2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.
- C. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by **[UL]** **[or]** **[LPI as a Master Installer/Designer]**, trained and approved for installation of units required for this Project.
- B. System Certificate:
 - 1. UL Master Label.
 - 2. LPI System Certificate.
 - 3. UL Master Label Recertification.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96 **[and NFPA 780]**.
- B. Roof-Mounted Air Terminals: NFPA 780, **[Class I]** **[Class II]**, **[aluminum]** **[copper]** unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following]** **[available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 2. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings]** **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - a. East Coast Lightning Equipment Inc.
 - b. ERICO International Corporation.
 - c. Harger.
 - d. Heary Bros. Lightning Protection Co. Inc.
 - e. Independent Protection Co.
 - f. Preferred Lightning Protection.
 - g. Robbins Lightning, Inc.
 - h. Thompson Lightning Protection, Inc.
 - i. **<Insert manufacturer's name>**.
 3. Air Terminals More than **24 Inches (600 mm)** Long: With brace attached to the terminal at not less than half the height of the terminal.
 4. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in Division 07 roofing Sections.
- C. Main and Bonding Conductors: **[Copper]** **[Aluminum]**.
- D. Ground Loop Conductor: The same size and type as the main conductor except tinned.
- E. Ground Rods: **[Copper-clad]** **[Zinc-coated]** **[Stainless]** steel[, **sectional type**]; **[3/4 inch (19 mm) in diameter by 10 feet (3 m)]** **[5/8 inch (16 mm) in diameter by 96 inches (2400 mm)]** long.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems according to **[UL 96A]** **[and]** **[NFPA 780]**.
- B. Conceal the following conductors:
 1. System conductors.
 2. Down conductors.
 3. Interior conductors.
 4. Conductors within normal view of exterior locations at grade within **200 feet (60 m)** of building.
- C. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

- D. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.
 - 1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.
- E. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.
- F. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.
- G. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of [structure] [area or item indicated].
 - 1. Bury ground ring not less than [24 inches (600 mm)] <Insert dimension> from building foundation.
 - 2. Bond ground terminals to the ground loop.
 - 3. Bond grounded building systems to the ground loop conductor within 12 feet (3.6 m) of grade level.
- H. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot (18-m) intervals.

3.2 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.3 FIELD QUALITY CONTROL

- A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
- B. UL Inspection: Meet requirements to obtain a UL Master Label for system.
- C. LPI System Inspection: Meet requirements to obtain an LPI System Certificate.

END OF SECTION 264113

SECTION 26 43 13 - SURGE PROTECTION FOR LOW VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Transient Voltage Surge Suppressors for Low-Voltage Power, Control, and Communication Equipment.
 - a. Service Entrance Suppressors
 - b. Plug-In Surge Suppressors
 - c. Control And Data Terminals
 - d. Enclosures

B. Related Sections:

1. Section 26 24 00– Switchboards and Panelboards
2. Section 26 24 26 - Wiring Devices

1.02 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE) Publications:

1. C62.41 “Surge Voltages In Low-Voltage AC Power Circuits”
2. C62.45, "IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits”

B. InterNational Electrical Testing Association (NICET)

C. National Electrical Manufacturer’s Association (NEMA) Standards Publications:

1. 250 “Enclosures for Electrical Equipment (1000 Volts Maximum)”
2. WD 6 “Wiring Devices—Dimensional Requirements”

D. National Institute for Certification in Engineering Technologies (NETA)

1. ATS “Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems”

E. National Fire Protection Association (NFPA) Publications:

1. 70 "National Electric Code"

F. Underwriter's Laboratories, Inc. (UL) Publications:

1. 486A “Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors”
2. 486B “Standard for Wire Connectors for Use with Aluminum Conductors”
3. 1283 “Electromagnetic Interference Filters”
4. 1449 “Transient Voltage Surge Suppressors”

1.03 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 indicating specified items selected for use in Project and with the following supporting data:
 - 1. Product Certificates: Signed by manufacturers of transient voltage suppression devices, certifying that products furnished comply with the following testing and labeling requirements:
 - a. UL 1283 certification.
 - b. UL 1449 listing and classification.
 - 2. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Failed test results and corrective action taken to achieve requirements.
 - 3. Maintenance Data: For transient voltage suppression devices to include in maintenance manuals specified in Division 01.
 - 4. Warranties: Special warranties specified in this Section.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.
- B. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, dimensional requirements, and electrical performance of suppressors and are based on the specific system indicated.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. IEEE Compliance: Comply with IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide for Surge Suppressor Testing."
- F. UL Compliance: Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449, third edition, "Transient Voltage Surge Suppressors."

1.05 PROJECT CONDITIONS

- A. Placing into Service: Do not energize or connect service entrance equipment to their sources until the surge protective devices are installed and connected.
- B. 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 representative not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's representative written permission.
- C. Service Conditions: Rate surge protective devices for continuous operation under the following conditions, unless otherwise indicated:
 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 2. Operating Temperature: 30 to 120 deg F.
 3. Humidity: 0 to 85 percent, non-condensing.
 4. Altitude: Less than 20,000 feet above sea level.

1.06 COORDINATION

- A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

1.07 WARRANTY

- A. General Warranty: 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. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of surge suppressors that fail in materials or workmanship within Five (5) years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 1. Broad Line of Suppressors:
 - a. Current Technology, Inc.
 - b. Liebert Corp.
 - c. Square D Co.; a Division of Group Schneider
 2. Category A and Telephone/Data Line Suppressors:
 - a. MCG Electronics, Inc.
 - b. NTE Electronics, Inc.
 - c. Telebyte Technology, Inc.

2.02 SERVICE ENTRANCE SUPPRESSORS

- A. Surge Protective Device Description: Modular design with field-replaceable modules and the following features and accessories:
 1. Fuses, rated at 200-kA interrupting capacity.
 2. Fabrication using bolted compression lugs for internal wiring.

3. Integral disconnect switch.
 4. Redundant suppression circuits.
 5. Redundant replaceable modules.
 6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 7. Red and green LED indicator lights for power and protection status.
 8. Audible alarm, with silencing switch, to indicate when protection has failed.
 9. One set of dry contacts rated at 5 a and 250-V ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.
 10. Surge-event operations counter.
- B. Peak Single-Impulse Surge Current Rating: 240kA per phase.
- C. Connection Means: Permanently wired.
- D. Protection modes and UL 1449, third edition, clamping voltage for grounded wye circuits with voltages of 208Y/120; 3-phase, 4-wire circuits, shall be as follows:
1. Line to Neutral: 700 V for 208Y/120.
 2. Line to Ground: 700 V for 208Y/120.
 3. Neutral to Ground: 700 V for 208Y/120.

2.03 PLUG-IN SURGE SUPPRESSORS

- A. Description: Non-modular, plug-in suppressors with at least four 15-A, 120-V ac, NEMA WD 6, Configuration 15-15R receptacles, suitable to plug into a NEMA WD 6, Configuration 15-15R receptacle; with the following features and accessories:
1. LED indicator lights for power and protection status.
 2. LED indicator lights for reverse polarity and open outlet ground.
 3. Circuit breaker and thermal fusing. Unit continues to supply power if protection is lost.
 4. Close-coupled direct plug-in.
 5. Rocker-type on-off switch, illuminated when in the on position.
 6. One RJ11/12C telephone line protector, suitable for modem connection. Maximum clamping voltage 220 peak on pins No. 3 and 4.
- B. Peak Single-Impulse Surge Current Rating: 26 kA per phase.
- C. Protection modes and UL 1449 clamping voltage shall be as follows:
1. Line to Neutral: 475 V.
 2. Line to Ground: 475 V.
 3. Neutral to Ground: 475 V.

2.04 CONTROL AND DATA TERMINALS

- A. Protectors for copper control, data, antenna and telephone conductors entering the building from the outside shall be as recommended by the manufacturer for the type of line being protected.

2.05 ENCLOSURES

- A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 EXECUTION

3.01 INSTALLATION OF SURGE PROTECTIVE DEVICES

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install devices for panelboard and auxiliary panels with conductors between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - 1. Provide multi-pole, 15-A circuit breaker as a dedicated disconnect for the suppressor, unless otherwise indicated.

3.02 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 and UL 486B.

3.03 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing surge protective devices, but before electrical circuitry has been energized, test for compliance with requirements.
 - 2. Complete startup checks according to manufacturer's written instructions.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 07.19. Certify compliance with test parameters.
- B. Repair or replace malfunctioning units. Retest after repairs or replacements are made.

3.04 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain surge protective devices.
 - 1. Train Owner's maintenance personnel on procedures and schedules for maintaining suppressors.
 - 2. Review data in maintenance manuals. Refer to Section 01 78 23 - "Operation and Maintenance Data."
 - 3. Schedule training with Owner, through Owner representative, with at least seven days' advance notice.

END OF SECTION

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Interior Lighting Fixtures
2. Lamps
3. Ballasts
4. Exit Signs
5. Emergency Lighting Units
6. Accessories

B. Related Sections:

1. Section 09 51 23 - Acoustical Tile Ceilings
2. Section 26 05 00 - Common Work Results For Electrical.
3. Section 26 56 00 - Exterior Lighting
4. Section 26 60 00 - Lighting Accessories: For programmable lighting control systems, time switches, additional photoelectric relays, power relays, and contactors.

1.02 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. C82.4 "Ballasts for High – Intensity – Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type)"

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE) Publications:

1. C62.41 "Surge Voltages in Low-Voltage AC Power Circuits"

C. Illuminating Engineering Society (IES) Publications:

1. LM-79 "Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products"
2. LM-80 "Approved Method: Measuring Lumen Maintenance of LED Light Sources"

D. National Fire Protection Association (NFPA) Publications:

1. NFPA 70 "National Electric Code"
2. NFPA 101 "Life Safety Code®"

E. Underwriter's Laboratories, Inc. (UL) Publications:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"
3. 924 "Emergency Lighting and Power Equipment"

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
 - a. Dimensions of fixtures.

- b. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - c. Emergency lighting unit battery and charger.
 - d. Fluorescent and high-intensity-discharge ballasts.
 - e. Types of lamps.
 - f. Photometric data.
2. Dimming Ballast Compatibility Certificates: Signed by manufacturer of ballast certifying that ballasts are compatible with dimming systems and equipment with which they are used.
 3. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
 4. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 01.

1.04 QUALITY ASSURANCE

- A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.
- C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.05 COORDINATION

- A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.06 EXTRA MATERIALS

- A. Furnish extra materials described in Section 01 78 43 "Spare Parts and Materials" that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 1. Refer to Lighting Fixture Schedule for Detailed Information.
 2. 2nd Avenue Design (800-843-1602)
 - a. Contact: Jan Zanger (800-544-4879)
 3. 3Form, Inc. (800-726-0126)
 - a. Contact: Janice Eldredge (801-649-2599)
 4. Acclaim Lighting (706-868-5451)
 5. Ashley Lighting Inc. (870-483-6184)
 - a. Contact: Laurie Foster (870-483-6181)
 6. B-K Lighting
 - a. Contact: Kahn Wright (301-470-3282)
 7. Broan-NuTone LLC (513-936-4200)
 - a. Contact: Ron Greene (301-599-0101)
 8. Challenger Lighting Company (847-717-4700)
 - a. Contact: Peggy Hart (301-260-2161 x 13)

9. Continental Group (614-679-1201)
 - a. Contact: Sean Snyder (614-679-1201)
10. Cree LED Lighting Solutions (919-287-7700)
 - a. Contact: Mark Wanless (708-505-4227)
 - b. To obtain special volume pricing and accuracy, contact:
 - 1) Wiedenbach-Brown Co., Inc.
Attn: Buck Buchanan (917-566-4848) or Christine Sturm (800-243-0043 x 353)
11. D'Style, Inc. (619-662-0560)
 - a. Contact: Jacob Shor (619-662-0560 x 118)
12. Electric Mirror LLC (425-776-4946)
 - a. Contact: Doug Finefrock (425-776-4946)
13. ExceLine, a Philips Group Brand (800-334-2212)
 - a. Contact: Kathleen Kenny (813-760-3421)
14. Forecast, a Philips Group Brand (847-622-0416)
 - a. Contact: Kathleen Kenny (813-760-3421)
15. Hadco, a Philips Group Brand (800-331-4185)
 - a. Contact: Kathleen Kenny (813-760-3421)
16. InLight, a Unilight International Co. (800-361-0472)
 - a. Contact: Patrice Adore (301-873-5234)
17. Insight Lighting Inc. (262.524.2010)
 - a. Contact: Heather Reed (301-338-1116)
18. io LED Cooper Lighting (713-209-8400)
19. Kichler Lighting (216-573-1005)
 - a. Contact: Peggy Hart (301-260-2161 x 13)
20. LBL Lighting, a Generation Brands Company (847-626-6304)
 - a. Contact: Joe Krause (301-537-5808)
21. Lightolier, a Philips Group Brand (508-679-8131)
 - a. Contact: Kathleen Kenny (813-760-3421)
22. Lithonia Lighting, Accuity Brands, Inc. (770-992-9000)
23. Lumark Lighting, Division of Cooper Industries Company (770-486-4800)
 - a. Contact: Mike Larkin (301-953-2020 x 239)
24. Lukas Lighting (800-841-4011)
 - a. Contact: Craig Corona (718-706-0595)
25. LUMAPRO
26. Lumiere, Division of Cooper Industries Company (770-486-4800)
27. iWORKS (LUDO Lamp) (323-278-8363)
 - a. Contact: Michele Chan (323-278-8363)
28. Ledra, by Bruck Lighting Systems, Inc. (714-259-9959)
29. Lyte Poles Incorporated (586-774-5650)
 - a. Contact: Kathleen Kenny (813-760-3421)
30. MaxLite (800-555-5629)

- a. Contact: Bill Masi (908-672-1665)
- 31. National Specialty Lighting, Inc. (800-527-2923)
- 32. Pacific Coast Lighting (800-709-9004)
 - a. Contact: Christopher Bryan (800-905-7225)
- 33. Panasonic (866-292-7292)
 - a. Contact: Angy Steiner (262-670-9822)
- 34. Lithonia Lighting, Accuity Brands, Inc. (510-845-2760)
- 35. Philips Color Kinetics
 - a. Contact: Kathleen Kenny (813-760-3421)
- 36. Philips Lighting Company (800.555.0050)
 - a. Contact: Kathleen Kenny (813-760-3421)
- 37. Progress Lighting (864.599.6000)
 - a. Contact: Rob Anderson (757-547-8050)
- 38. Project Light (877-688-9005)
 - a. Contact: Sam Avny (561-847-0322)
- 39. Quoizel Lighting (631-273-2700)
 - a. Contact: Hope Steen (843-574-3457)
- 40. Renaissance Lighting, Gotham Lighting, Accuity Brands, Inc. (800-315-4982)
 - a. Contact: Troy Cook (540-342-1548)
- 41. Resolute, (206-343-9323)
 - a. Contact: Holly Finn (206-452-1468)
- 42. RSA, a Cooper Lighting Brand (713-209-8400)
- 43. Scott Lamp Company (707-864-2066)
 - a. Contact: Leanne Weber-Kreis (301-440-6740)
- 44. Stonco Lighting, a Philips Group Brand (800-334-2212)
 - a. Contact: Kathleen Kenny (813-760-3421)
- 45. TCP, Inc. (800-324-1496)
 - a. Contact: Scott Carroll (216-372-2736)
- 46. Tech Lighting, a Generation Brands Company (847-410-4400)
 - a. Contact: To obtain special volume pricing and accuracy, contact:
 - 1) Valley Lighting, Linthicum, MD (800-932-6012)
- 47. Translite Sonoma, a Philips Group Brand (707-996-6906)
 - a. Contact: Kathleen Kenny (813-760-3421)
- 48. Trend Lighting, a McFadden Lighting Company (314 773-1340)
 - a. Contact: Rob Bruck (626-480-8880)
- 49. Trinity Lighting, Inc. (870-972-1177)
 - a. Contact: Angie Allison (870-972-1177)
- 50. Van Teal, Inc. (305-751-6767)
 - a. Contact: Joey Rogers (336-549-1274)
- 51. Wide-Lite, a Philips Group Brand (512.392.5821)
 - a. Contact: Kathleen Kenny (813-760-3421)

2.02 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit re-lamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during re-lamping and when secured in operating position.
- D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
 - 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
 - 2. Lens Thickness: 0.125 inch minimum, unless greater thickness is indicated.

2.03 FLUORESCENT LAMP BALLASTS

- A. General Requirements: Unless otherwise indicated, features include the following:
 - 1. Designed for type and quantity of lamps indicated at full light output.
 - 2. Total Harmonic Distortion Rating: Less than 20 percent.
 - 3. Sound Rating: A.
- B. Electronic Ballasts for Linear Lamps: Unless otherwise indicated, features include the following, besides those in "General Requirements" Paragraph above:
 - 1. Certified Ballast Manufacturer Certification: Indicated by label.
 - 2. Encapsulation: Without voids in potting compound.
 - 3. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
- C. Ballasts for Compact Lamps in Recessed Fixtures: Unless otherwise indicated, additional features include the following:
 - 1. Type: Electronic fully encapsulated in potting compound.
 - 2. Power Factor: 90 percent, minimum.
 - 3. Operating Frequency: 20 kHz or higher.
 - 4. Flicker: Less than 5 percent.
 - 5. Lamp Current Crest Factor: Less than 1.7.
 - 6. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
- D. Ballasts for Dimmer-Controlled Fixtures: Comply with general and fixture-related requirements above for electronic ballasts.
 - 1. Compatibility: Certified by manufacturer for use with specific dimming system indicated for use with each dimming ballast.
- E. Ballasts for Low-Temperature Environments: As follows:

1. Temperatures 0 Deg F Above: Electronic or electromagnetic type rated for 0 deg F starting temperature.
2. Temperatures Minus 20 Deg F and Above: Electromagnetic type designed for use with high-output lamps.

2.04 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

- A. General: Comply with ANSI C82.4. Unless otherwise indicated, features include the following:
1. Type: Constant wattage autotransformer or regulating high-power-factor type, unless otherwise indicated.
 2. Operating Voltage: Match system voltage.
 3. Minimum Starting Temperature: Minus 22 deg F for single lamp ballasts.
 4. Normal Ambient Operating Temperature: 104 deg F
 5. Open-circuit operation that will not reduce average life.
 6. Auxiliary, Instant-on, Quartz System: Automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. Automatically turns quartz lamp off when high-intensity-discharge lamp reaches approximately 60 percent light output.

2.05 EXIT SIGNS

- A. General Requirements: Comply with UL 924 and the following:
1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.
- B. Internally Lighted Signs: As follows:
1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.
- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically energizes lamp from unit when circuit voltage drops to 80 percent of nominal or below. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.06 EMERGENCY LIGHTING UNITS

- A. General Requirements: Self-contained units. Comply with UL 924. Units include the following features:
1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.
 4. Integral Time-Delay Relay: Arranged to hold unit on for fixed interval after restoring power after an outage. Provides adequate time delay to permit high-intensity-discharge lamps to restrike and develop adequate output.

2.07 LED FIXTURES

- A. Fixtures shall be UL or Intertek (ETL) Listed.

- B. Drivers shall be capable of accepting the voltage indicated on the [schedule] [drawings] and capable of dimming if required. The driver shall meet the following requirements:
 - 1. Class A Sound Rating
 - 2. Total Harmonic Distortion of less than 20 percent.
 - 3. Operating temperature between -40 degree Celsius and 40 degrees Celsius.
 - 4. Driver shall not contain any Polychlorinated Biphenyl (PCB).
- C. All LED fixtures shall be tested to IES LM-79 and IES LM-80 and meet the following:
 - 1. Fixture Efficacy (Lumens per watt): 60 or greater.
 - 2. Color Accuracy: Color Rendering Index (CRI): 70 or greater.
 - 3. Light Color: As indicated on lighting fixture schedule.
 - 4. Outdoor fixtures shall be IP65 Rated.
 - 5. LEDs, driver and all components shall have a system lifetime of 50,000 hours or more at 25 degrees Celsius.
 - 6. Fixture shall have a minimum of a five year warranty on all components and finishes.

2.08 LAMPS

- A. Fluorescent Color Temperature and Minimum Color-Rendering Index: 3500 K and 85 CRI, unless otherwise indicated.
- B. Non-compact Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid-start circuits.
- C. Metal-Halide Color Temperature and Minimum Color-Rendering Index: 3600 K and 70 CRI, unless otherwise indicated.

2.09 FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 26/27 05 00 "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
- D. Rod Hangers: 3/16-inch- minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.10 FINISHES

- A. Fixtures: Manufacturer's standard, unless otherwise indicated.
 - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
 - 2. Metallic Finish: Corrosion resistant.
 - 3. Colors as indicated in Light Fixture Matrix.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.

- B. Support for Fixtures in or on Grid-Type Suspended Ceilings:
 - 1. Recessed lighting fixtures shall be supported independently from the suspended ceiling system. Number 8 gauge galvanized steel wire or approved type hangers from the overhead building structures shall be provided for fixture support.
- C. Suspended Fixture Support: As follows:
 - 1. Pendants and Rods: Where longer than 48 inches brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on Drawings.

3.02 CONNECTIONS

- A. Ground Equipment.
 - 1. 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 and UL 486B.

3.03 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests: As follows:
 - 1. Verify normal operation of each fixture after installation.
 - 2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
 - 3. Verify normal transfer to battery source and retransfer to normal.
 - 4. Report results in writing.
- E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- F. Corrosive Fixtures: Replace during warranty period.

3.04 CLEANING AND ADJUSTING

- A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION

SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Exterior Lighting Units with Luminaires
2. Ballasts
3. Lamps
4. Luminaire Support Components
5. Accessories

B. Related Sections:

1. Section 03 30 00 - Cast-in-Place Concrete.
2. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
3. Section 26 51 00 - Interior Lighting
4. Section 26 60 00 - Lighting Accessories: For programmable lighting control systems, time switches, additional photoelectric relays, power relays, and contactors.

1.02 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. C2 "National Electrical Safety Code"
2. C78 "Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)"
3. C82.4 "Ballasts for High – Intensity – Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type)"

B. American Association of State Highway and Transportation Officials (AASHTO) Publications:

1. LTS-3 "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals"

C. ASTM International (ASTM) Publications: (Former American Society for Testing and Materials)

1. A123 "Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products"
2. A500 "Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes"
3. B660 "Standard Practices for Packaging/Packing of Aluminum and Magnesium Products"

D. Illuminating Engineering Society (IES) Publications:

1. RP-8 "Roadway Lighting"

E. National Fire Protection Association (NFPA) Publications:

1. NFPA 70 "National Electric Code"

F. National Association of Architectural Metal Manufacturers (NAAMM) Publications:

1. "Metal Finishes Manual for Architectural and Metal Products"

G. Underwriter's Laboratories, Inc. (UL) Publications:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
2. 486B "Standard for Wire Connectors for Use with Aluminum Conductors"

1.03 DEFINITIONS

- A. Lighting Unit: A luminaire or an assembly of luminaires complete with a common support, including pole, post, or other structure, and mounting and support accessories.
- B. Luminaire (Light Fixture): A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

1.04 SUBMITTALS

- A. Submit "Letter of Conformance" in accordance with Section 01 33 00 indicating specified items selected for use in Project with the following supporting data:
 1. For each type of lighting unit indicated, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - a. Materials and dimensions of luminaires and poles.
 - b. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - c. High-intensity-discharge luminaire ballasts.
 - d. Photometric data.
 2. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 3. Maintenance Data: For lighting units to include in maintenance manuals specified in Division 01.

1.05 QUALITY ASSURANCE

- A. Luminaires and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use, location, and installation conditions by a testing agency acceptable to authorities having jurisdiction
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING OF POLES

- A. Package aluminum poles for shipping according to ASTM B660.
- B. Store poles on decay-resistant treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent surface more than 1/4 inch deep. Do not apply tools to section of poles below ground-line.

- D. Retain factory-applied pole wrappings on fiberglass poles until just before pole installation. Handle poles with web fabric straps.
- E. Retain factory-applied pole wrappings on metal poles until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described in section 01 78 43 "Spare Parts and Materials" that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Avendra, LLC Preferred Manufacturers:
 - 1. Refer to Section 26 51 00 for list of approved manufacturers.
- B. Approved Manufacturers:
 - 1. Subject to compliance with requirements, provide the products indicated for each designation in the Light Fixture Matrix attached at the end of this Section.
 - 2. Refer to Section 26 51 00 for list of approved manufacturers.

2.02 LUMINAIRES

- A. Comply with IES RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- B. Metal Parts: Free from burrs, sharp corners, and edges.
- C. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit re-lamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during re-lamping and when secured in operating position. Provide for door removal for cleaning or replacing lens. Arrange to disconnect ballast when door opens.
- F. Exposed Hardware Material: Stainless steel.
- G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
- H. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- I. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor in luminaire doors.
- J. Photoelectric Relays: As follows:

1. Contact Relays: Single throw, arranged to fail in the on position and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.
2. Relay Mounting: In luminaire housing.
- K. High-Intensity-Discharge Ballasts: Comply with ANSI C82.4. Constant wattage autotransformer or regulating high-power-factor type, unless otherwise indicated.
 1. Ballast Fuses: One in each ungrounded supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
 2. Single-Lamp Ballasts: Minimum starting temperature of minus 40 deg C.
 3. Open-circuit operation will not reduce average life.
 4. Noise: Uniformly quiet operation, with a noise rating of B or better.
- L. Lamps: Comply with the standard of the ANSI C78 series that is applicable to each type of lamp. Provide luminaires with indicated lamps of designated type, characteristics, and wattage. Where a lamp is not indicated for a luminaire, provide medium wattage lamp recommended by manufacturer for luminaire.
 1. Metal-Halide Color Temperature and Minimum Color-Rendering Index: 3600 K and 70 CRI, unless otherwise indicated.

2.03 LUMINAIRE SUPPORT COMPONENTS

- A. Description: Comply with AASHTO LTS-3 for pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.
- B. Wind-Load Strength of Total Support Assembly: Adequate to carry support assembly plus luminaires at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 100 mph (160 km/h) with a gust factor of 1.3. Support assembly includes pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.
 1. Strength Analysis: For each pole type and luminaire combination, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- C. Finish: Match finish of pole/support structure for arm, bracket, and tenon mount materials.
- D. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 1. Materials: Will not cause galvanic action at contact points.
 2. Mountings: Correctly position luminaire to provide indicated light distribution.
 3. Anchor Bolts, Nuts, and Washers: Hot-dip galvanized after fabrication unless stainless-steel items are indicated.
 4. Anchor-Bolt Template: Plywood or steel.
- E. Pole/Support Structure Bases: Anchor type with hold-down or anchor bolts, leveling nuts, and bolt covers.
- F. Steel Poles: Tubing complying with ASTM A500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 feet in length with access handhole in pole wall.

1. Grounding Provisions for Metal Pole/Support Structure: Welded 1/2-inch threaded lug, accessible through handhole and listed for copper conductor connection.
2. Shafts: Square, straight.
- G. Metal Pole Brackets: Match pole metal. Provide cantilever brackets without underbrace, in sizes and styles indicated, with straight tubular end section to accommodate luminaire.
- H. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- I. Concrete for Pole Foundations: Comply with Section 03 30 00 (03300) "Cast-in-Place Concrete."
 1. Design Strength: 3000-psi, 28-day compressive strength.

2.04 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Steel: Grind welds and polish surfaces to a smooth, even finish.
 1. Galvanized Finish: Hot-dip galvanize after fabrication to comply with ASTM A123.
 2. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 3. Interior: Apply one coat of bituminous paint on interior of pole, or otherwise treat to prevent corrosion.
 4. Polyurethane Enamel: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: Refer to Light Fixture Matrix.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Concrete Foundations: Construct according to Section 03 30 00 "Cast-in-Place Concrete."
 1. Comply with details for reinforcement and for anchor bolts, nuts, and washers. Verify anchor-bolt templates by comparing with actual pole bases furnished.
 2. Finish for Parts Exposed to View: Trowel and rub smooth. Comply with Section 03 30 00 (03300) - "Cast-in-Place Concrete" for exposed finish.
- B. Embedded Poles: Set poles to indicated depth, but not less than one-sixth of pole length below finish grade. Dig holes large enough to permit use of tampers the full depth of hole. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.
- C. Install poles as follows:
 1. Use web fabric slings (not chain or cable) to raise and set poles.
 2. Mount pole to foundation with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 3. Secure poles level, plumb, and square.

4. Grout void between pole base and foundation. Use non-shrinking or expanding concrete grout firmly packed in entire void space.
 5. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- D. Luminaire Attachment: Fasten to indicated structural supports.
- E. Luminaire Attachment with Adjustable Features or Aiming: Attach luminaires and supports to allow aiming for indicated light distribution.
- F. Lamp luminaires with indicated lamps according to manufacturer's written instructions. Replace malfunctioning lamps.

3.02 CONNECTIONS

- A. Ground equipment.
1. 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 and UL 486B.
- B. Ground metal poles/support structures according to Section 26 05 26 - "Grounding and Bonding for Electrical Systems."
1. Nonmetallic Poles: Ground metallic components of lighting units and foundations. Connect luminaires to grounding system with No. 6 AWG conductor.

3.03 FIELD QUALITY CONTROL

- A. Inspect each installed unit for damage. Replace damaged units.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source, and as follows:
1. Measure light intensities at night if specific illumination performance is indicated. Use photometers with calibration referenced to NIST standards.
 2. Check intensity and uniformity of illumination.
 3. Check excessively noisy ballasts.
- E. Prepare a written report of tests, inspections, observations and verifications indicating and interpreting results.
- F. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

3.04 CLEANING AND ADJUSTING

- A. Clean units after installation. Use methods and materials recommended by manufacturer.
- B. Adjust amiable luminaires and luminaires with adjustable lamp position to provide required light distributions and intensities.

END OF SECTION

SECTION 26 60 00 - LIGHTING ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Time Switches
2. Photoelectric Relays
3. Multi-pole Lighting Relays and Contactors.
4. Hearing Impaired Door Annunciator
5. Occupancy Sensors
 - a. Indoor Occupancy Sensors
 - b. Switchbox-Mounted Occupancy Sensors

B. Related Sections:

1. Section 01 81 13 - Sustainable Design Requirements
2. Section 10 14 00 - Signage
3. Section 26 05 00 - Common Work Results For Electrical.
4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
5. Section 26 05 33 - Raceways and Boxes For Electrical Systems.
6. Section 26 05 53 - Identification for Electrical Systems.
7. Section 26 24 00 - Switchboards and Panelboards
8. Section 26 27 26 - Wiring Devices: For wall-box dimmers and manual light switches.

1.02 REFERENCES

A. American National Standards Institute (ANSI) Publications:

1. C62.41 "IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits"

B. National Electrical Manufacturer's Association (NEMA) Standards Publications:

1. ICS 2 "Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 6000 Volts"

C. National Fire Protection Association (NFPA) Publications:

1. NFPA 70 "National Electric Code"

D. Underwriter's Laboratories, Inc. (UL) Publications:

1. 486A "Standard For Wire Connectors and Soldering Lugs for Use with Copper Conductors"
2. 508 "Standard for Industrial Control Equipment"
3. 773A "Nonindustrial Photoelectric Switches for Lighting Control"
4. 917 "Standard for Safety for clock-Operated Switches"
5. 1449 "Transient Voltage Surge Suppressors"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Submit "Letter of Conformance" in accordance with Section 01 33 00 (01330) indicating specified items selected for use in project with the following supporting data.

1. Product Data:

- a. Include dimensions and data on features, components, and ratings for lighting control devices.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use and installation conditions by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.

1.05 COORDINATION

- A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions. Include coordination with the following:
 - 1. Section 26 24 00 - "Switchboards and Panelboards."

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers:

1. Contactors and Relays:

- a. Challenger Electrical Equipment Corp.
- b. Cutler-Hammer Products; Eaton Corporation
- c. GE Lighting Controls
- d. Hubbell Lighting, Inc.
- e. Siemens Energy and Automation, Inc.
- f. Square D Co.; a Division of Groupe Schneider, Power Management Organization

2. Time Switches:

- a. Diversified Electronics, Inc.
- b. Intermatic, Inc.
- c. Tork, Inc.
- d. Leviton Manufacturing Co., Inc.

3. Photoelectric Relays

- a. Allen-Bradley/Rockwell Automation
- b. Intermatic, Inc.
- c. Rhodes: M H Rhodes, Inc.
- d. Tork, Inc.

4. Occupancy Sensors:

- a. Honeywell, Inc.; Home and Building Controls
- b. Hubbell Lighting, Inc.
- c. Leviton Manufacturing Co., Inc.
- d. Lutron Electronics Co., Inc.
- e. Philips Lighting Company
- f. Watt Stopper, Inc. (The)

5. Hearing Impaired Door Annunciator:

a. Edwards Signaling, UTC Fire & Security

2.02 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: Include in all 120- and 277-V solid-state equipment. Comply with UL 1449 and with ANSI C62.41 for Category A locations.

2.03 HEARING IMPAIRED DOOR ANNUNCIATOR.

- A. Guestroom Door Annunciator Kit: Visual signaling device with strobe, hall push button station, and transformer. Minimum high intensity 150 candela visual signal.
- B. Approved Manufacturer:
1. Edwards Signaling
- C. The kit shall consist of the following components:
1. Push Button: No. 20
 2. Cover Plate: No. 147-10
 3. Strobe in location shown on Drawings: No. 89STR (B)-AQ
 4. Auxiliary Strobe in bathroom: No. 89STR (B)-AQ
 5. Below strobes provide a small plaque in off-white plastic with black letters that reads "DOOR BUTTON SIGNALER" as well as Braille equivalent. Secure to wall with clear sanitary sealant.
 - a. Plaque: By Section 10 14 00 (Interior Signage Package).
 6. Transformer: No. 598
- D. A disconnect switch from the door button power transformer shall be located on the wall in location shown on Drawings with an applied label on the cover plate reading "DOOR SIGNAL OVERRIDE".
1. Plaque: By Section 10 14 00 (Interior Signage Package).
- E. Mount the push button at 48" above the floor on the corridor side next to the lock strike of the door.
- F. Mount the strobe on the wall in location shown on Drawings at 80" above the floor.
- G. Mount the auxiliary strobe on the bathroom wall in location shown on Drawings at 80" above the floor.
- H. Screw components to walls using plastic plugs.

2.04 HEARING IMPAIRED DOOR ANNUNCIATOR.

- A. Guestroom Door Annunciator Kit: Audible/visual signaling device with horn/strobe, hall push button station, and transformer. Minimum 82 dB sound pressure at 10 feet and a high intensity 110 candela visual signal.
1. "Model 7005-G5 Hotel Room Annunciator Kit"; Edwards Signaling
 - a. Kit consisting of the following components:
 - 1) Model 6536-G5 Horn Strobe
 - 2) Model 592 Transformer
 - 3) Model 620 Push Button
 - 4) (Do not use 147-10 Face Plate)
 - b. Model 147-1 Face Plate (No text on plate).
 2. Locations as shown on Drawings.
Plaque: By Section 10 14 00 (Interior Signage Package).
- B. Doorbell Disable Switch:

1. Single Pole Toggle Switch: Refer to Section 26 27 26 .
2. Cover Plate: Refer to Section 26 27 26 .
3. Plaque: By Section 10 14 00 (Interior Signage Package).
4. Location as shown on Drawings.

2.05 TIME SWITCHES

- A. Description: Solid-state programmable units with alphanumeric display complying with UL 917.
 1. Astronomic dial.
 2. Two contacts, rated 30 A at 277-V ac, unless otherwise indicated.
 3. Two pilot-duty contacts, rated 2 A at 240-V ac, unless otherwise indicated.
 4. Eight-day program uniquely programmable for each weekday and holidays.
 5. Skip-day mode.

2.06 PHOTOELECTRIC RELAYS

- A. Description: Solid state, with single-pole, double-throw dry contacts rated to operate connected relay or contactor coils or microprocessor input, and complying with UL 773A.
- B. Light-Level Monitoring Range: 0 to 3500 fc with an adjustment for turn-on/turn-off levels.
- C. Time Delay: Prevents false operation.
- D. Outdoor Sealed Units: Weathertight housing, resistant to high temperatures and equipped with sun-glare shield and ice preventer.

2.07 MULTI-POLE CONTACTORS AND RELAYS

- A. Description: Electrically operated and mechanically held, and complying with UL 508 and NEMA ICS 2.
 1. Current Rating for Switching: UL listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballasts with 15 percent or less total harmonic distortion of normal load current).
 2. Control Coil Voltage: Match control power source.

2.08 INDOOR OCCUPANCY SENSORS

- A. 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.
 - B. 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.
- 2.09 SWITCHBOX-MOUNTED OCCUPANCY SENSORS
- A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
 - 1. Listed and labeled as defined in NEPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
 - 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.
 - B. Wall-Switch Sensor (180-degree field of view):
 - 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 type.
 - 5. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 - 6. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 - 7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
 - C. Wall-Switch Sensor (210-degree field of view):
 - 1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft.
 - 2. Sensing Technology: PIR.
 - 3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
 - 4. Voltage: Match the circuit voltage 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. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.

8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment level and plumb and according to manufacturer's written instructions.
- B. Mount lighting control devices according to manufacturer's written instructions and requirements in Section 26 05 00 - "Common Work Results for Electrical".
- C. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounting devices.

3.02 CONTROL WIRING INSTALLATION

- A. Install wiring between sensing and control devices according to manufacturer's written instructions and as specified in Section 26 05 19 - "Low-Voltage Electrical Power Conductors and Cables" for low-voltage connections.
- B. Wiring Method: Install all wiring in raceway as specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- C. Bundle, train, and support wiring in enclosures.
- D. Ground equipment.
- E. Connections: 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.

3.03 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 05 53 - "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

- A. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.
- B. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the Contract Documents.
- C. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.
- D. Verify settings of photoelectric devices with photometer calibrated within previous six months.
- E. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:
 1. Continuity tests of circuits.
 2. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
 - a. Include testing of devices under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.
- F. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
- G. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

- H. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.05 CLEANING

- A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

3.06 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested, to adjust light levels, make program changes, and adjust sensors and controls to suit actual conditions.
 - 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.

END OF SECTION